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**AIR QUALITY DATA SUMMARY
REGIONAL MUNICIPALITY OF
HAMILTON-WENTWORTH**

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GOVERNMENT DOCUMENTS

JANUARY 1996



Ontario

**Ministry of
Environment
and Energy**

Ministry of
Environment
and Energy

Ministère de
l'Environnement
et de l'Énergie

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February 8, 1996

See Distribution List

Dear Sir/Madam:

Re: 1994 Hamilton/Wentworth Air Quality Report

Attached for your information is a copy of the above report which summarizes the results of air monitoring in Hamilton-Wentworth during 1994.

Airborne particles, some organic contaminants and odorous sulphur compounds continued to exceed ambient objectives in Hamilton, primarily in the industrialized northeast section of the city. Abatement programs are underway at a number of industrial pollution sources to reduce these emissions.

Dust measurements near Redland Quarries have shown improvements over the last several years following various abatement efforts. However, dust emissions from fugitive sources at Redland during higher wind speeds continued to occasionally exceed objectives close to the plant.

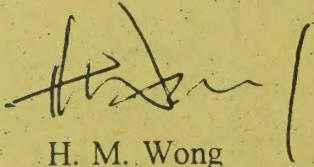
As well, common to the rest of Southern Ontario, ground level ozone continued to exceed objectives during the summer. Ozone is a serious respiratory irritant and is generated by chemical reactions from pollutants in the atmosphere. These pollutants can come from many sources, but most of the ozone originates from the U.S. Co-operative international action is taking place to reduce these levels by 2005. A hopeful sign is that the 1995 summer, although hot and sunny like 1988, did not result in the high ozone levels that occurred that year.

Several new local initiatives are taking place to address air quality concerns.

1. A public liaison group has been formed between citizen groups, industry and the Ministry to investigate the black fallout problem in the northeast end.
2. The Hamilton Air Quality Initiative has been started. This is a co-operative effort between the Ministry, various levels of government, academia, industry and the public. Participants will pool collective information on Hamilton air quality, estimate effects on the health and well being of the people and environment of the Region and recommend ways to improve air quality.

3. A computerized video camera system has been installed aimed at the industrial zone to determine which specific industries are responsible for fallout incidents and to view ongoing emissions.

For further information on air quality, please contact Mr. Frank Dobroff, Air Quality Analyst, or Dr. Denis Corr, Supervisor, Atmospheric and Terrestrial Effects; for information on specific industries please contact Mr. Carl Slater, Area Supervisor, Hamilton District Office. All these people may be contacted at (905) 521-7640.



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REGIONAL MUNICIPALITY OF
HAMILTON-WENTWORTH

JANUARY 1996



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1994 AIR QUALITY DATA SUMMARY
REGIONAL MUNICIPALITY OF
HAMILTON WENTWORTH

Report prepared by:

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Air Quality Assessment
West Central Region
Ministry of Environment and Energy

Report prepared for:

Ontario Ministry of Environment and Energy

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1. SUMMARY

Airborne particulates (dust), odours and semi-volatile organics have been Hamilton's main air pollution problems in recent years although improvements have been taking place. Dustfall (large settleable particles) has decreased by 30% since 1986 and suspended particulates by 14% since 1988. Odours due to reduced sulphur compounds have also reduced by 56 % since 1982.

Further improvements are still necessary, however, as dustfall still remained well above objectives in the industrial zone, and some residential parts of the City, and some odours continued to occur. Complaints about black fallout and odour are continuing. In response to this, a video camera system aimed at the industrial zone has been installed, to determine which specific industries are responsible for fallout incidents and to view ongoing emissions.

Levels of some pollutants increased from 1993. Further data will show if this is normal year to year variation or a trend.

The Air Pollution Index reached the advisory level of 32 three times at the downtown site. The Air Quality Index showed that suspended particles were the pollutants of greatest concern, reaching the moderate range of the Index most frequently of the six measured pollutants.

The network of fluoride monitors showed a continuing steady decline in concentrations, but levels near Hamilton Brick were well above objectives. Previous studies have shown that these levels are sufficient to cause vegetation damage near the plant. The company has failed to comply with requests for voluntary control actions. As a result, the Ministry is proceeding with mandatory abatement in the form of a Control Order

Common to the rest of Southern Ontario, ground level ozone continued to exceed criteria. It is largely a product of long range transport from the US and is produced photochemically to excess during the summer.

Measurements of volatile organics such as xylene and toluene showed low levels across the city, well within guidelines. Other semi-volatile organics known as polynuclear aromatic hydrocarbons (PAHs) exceeded guidelines for benzo(a)pyrene and levels were highest in the industrial zone and Beach Strip. Some of these compounds are human carcinogens, but the Medical Officer of Health considers the risk posed by these pollutants small. There are control programs at the major steel mills currently being implemented to reduce visible particulate emissions. These programs are expected to simultaneously reduce PAHs associated with coke oven operations. Benzene emission reduction programs are also expected to have a concurrent PAH reduction.

Airborne dust measurements near Redland Quarries, a limestone quarry in Flamborough, have shown clear improvements in dustfall and suspended particulate levels following the installation of new electrostatic precipitator at the company's processing plant and various other efforts to control fugitive dust. However, suspended particulate measurements continued to show a localized problem with some measurements still above objectives, probably due to fugitive dust emissions under higher wind speed conditions. The severity of the problem varies from year to year. The company has agreed to conduct voluntary stack testing at the processing plant. The results of the tests will establish whether compliance with regulatory limits is being achieved and will be used in modelling to assess the impact of emissions on the surrounding community.

2. INTRODUCTION

The Air Management Program in Ontario is based on controlling man-made emissions to meet ambient air quality objectives, which in turn are based on known effects on health, quality of life, sensitive vegetation or materials, whichever is most stringent. To achieve these objectives, sources of pollution are identified, their emissions evaluated and appropriate control measures are instituted. Ambient air monitoring is used to identify pollution sources and to verify that controls have been successful. Monitors are usually sited in areas suspected of experiencing higher levels of air pollution. When these areas achieve acceptable air quality, then it is assumed that other areas should also be acceptable.

3. MONITORING NETWORK

The Ministry of the Environment operates a network of ambient air monitors throughout Hamilton as shown in Figure 1 and Table 1. The network centres on six automated stations which continuously monitor a variety of pollutants and telemeter hourly averaged data to a central computer facility in Toronto. These stations are:

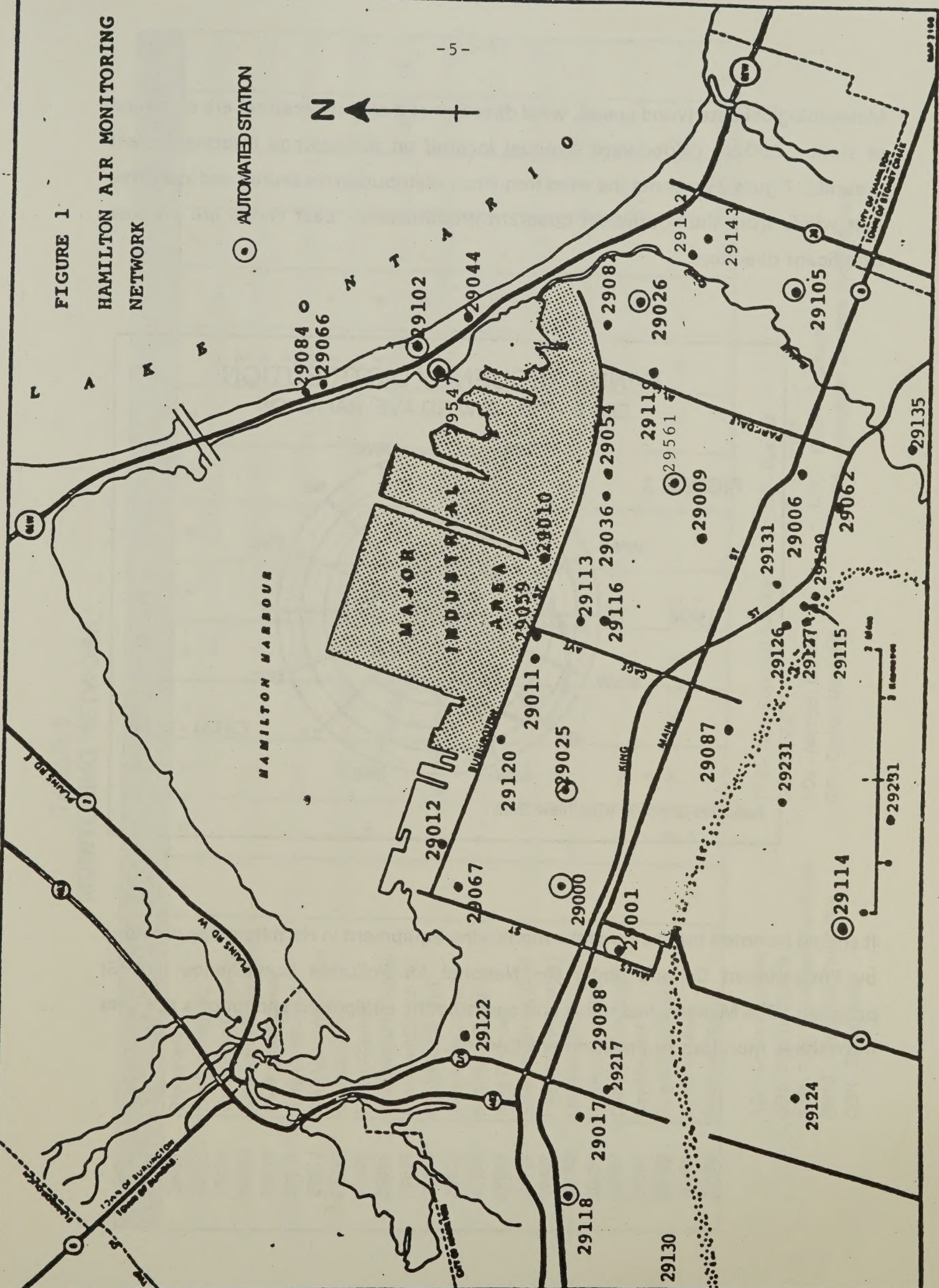
- 29000 - Elgin/Kelly, downtown
- 29025 - Barton/Sanford, between downtown and the industrial zone
- 29102 - Beach Blvd, normally downwind of the industrial zone
- 29105 - Nash/Kentley, in the east end
- 29114 - Vickers/East 18th, on the mountain
- 29118 - Main West/Highway 403, in the west end

The remainder of the network consists of some other telemetered instrumentation and many other less complex monitors, some of which have been in existence since 1970. In addition to this regular network, special surveys are sometimes carried out to evaluate specific problems.

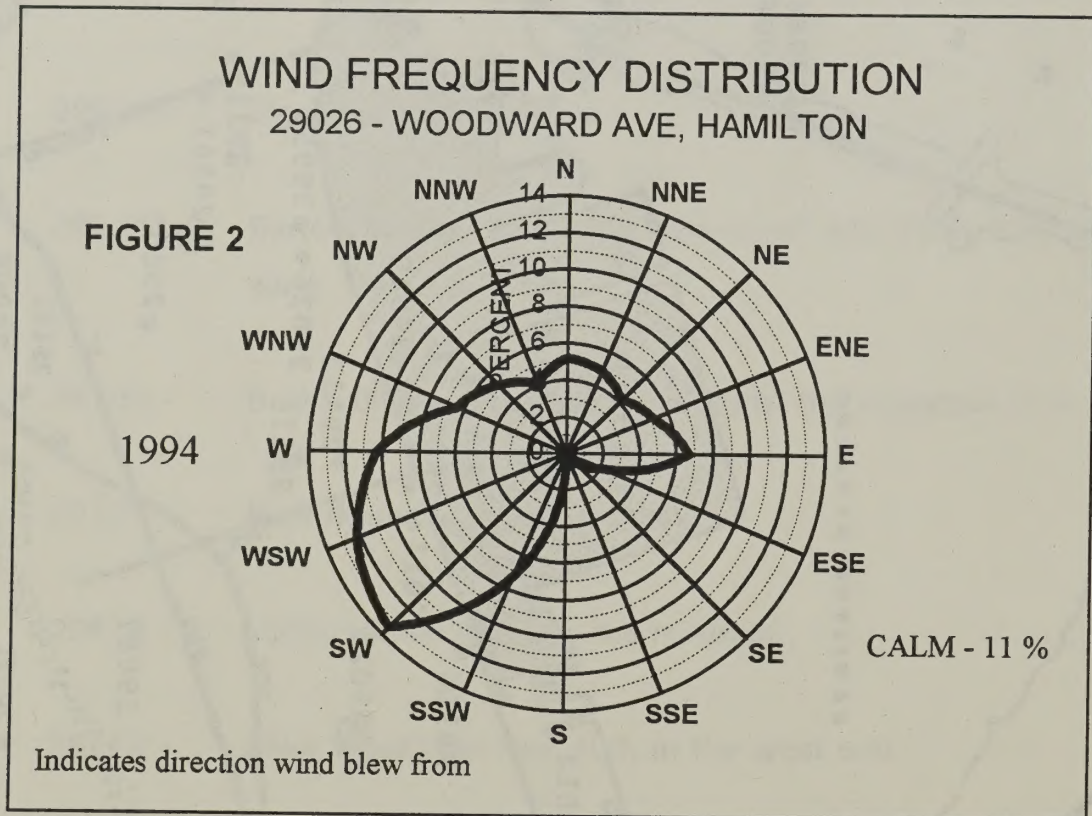
The Ministry continuously measured the Air Quality Index across the Province at 30 locations, including the Downtown, East, West, and Mountain stations in Hamilton. A description of the AQI and the 1994 results are presented in this report.

FIGURE 1

HAMILTON AIR MONITORING
NETWORK



Meteorological data (wind speed, wind direction and air temperature) are observed at station 29026, (Woodward Avenue) located on the sewage treatment plant grounds. Figure 2 presents the wind frequency distribution measured and indicates that winds from the southwest quadrant predominate. East winds are another significant direction.



It should be noted that some of the monitoring equipment in Hamilton was provided by Environment Canada under the National Air Pollution Surveillance (NAPS) program. The Ministry maintains and operates the equipment and reports the data from these monitors to Environment Canada.

TABLE 1
MONITORING NETWORK

STATION NUMBER	LOCATION	AQI	SO2	TSP	PM10	COH	TRS	O3	NOx	CO	DF	F	VOC	PAH	WIND	TEMP
29000	Elgin/Kelly	x	x	x	x	x	x	x	x	x	x	x	x			
29001	Hughson/Hunter					x										
29006	Queenston/Craigroyston															
29009	Kenilworth/Roxborough			x												
29010	Burlington/Ottawa															
29011	Burlington/Leeds			x												
29012	Burlington/Wellington															
29017	Chatham/Frid			x								x				
29025	Barton/Sanford		x	x		x	x					x				
29026	Woodward/Brampton															
29036	Roosevelt/Beach Rd															
29044	Wark/Beach Blvd															
29054	Beach Rd/Conrad															
29059	Burlington/Gage															
29062	King E/Barons															
29066	Killamey/Beach Blvd															
29067	Hughson N/Macauley			x												
29082	Leaside/ Knox															
29084	Rembe/Beach Blvd															
29087	Cumberland/Prospect			x												
29098	Bay/Main W			x												
29102	Beach Blvd/Towers		x	x	x	x	x									
29105	Nash/Kentley	x	x													
29113	Gertrude/Depew			x												

AQI - Air Quality Index	TRS - Total Reduced Sulphur	DF - Dustfall
SO2 - Sulphur Dioxide	O3 - Ozone	F - Fluoride
TSP - Total Suspended Particulate	NOx - Nitrogen Oxides	VOC - Volatile Organics
PM10 - Respirable Particulate	CO - Carbon Monoxide	PAH - Polynuclear Aromatic Hydrocarbons
COH - Soiling Index		

TABLE 1 (cont'd)
MONITORING NETWORK

STATION NUMBER	LOCATION	AQI	SO2	TSP	PM10	COH	TR5	O3	NOx	CO	DF	F	VOC	PAH	WIND	TEMP
29114	Vickers/E 18th	x	x	x	x	x	x	x	x			x	x	x		
29115	London/Justine											x				
29116	Dalkeith/Ottawa											x				
29118	Main W/Hwy 403	x	x	x		x	x	x	x	x		x				
29119	Morley/Parkdale			x								x				
29120	12 Dickson											x				
29122	Dundurn/York			x								x				
29124	Buchanan Park School			x	x											
29126	Rossllyn/Montclair											x				
29127	Lawrence/Balmoral											x				
29129	Province/Justine											x				
29130	Ewen/Whitney			x								x				
29131	Central/Graham															
29135	Albright/Mt Albion			x								x				
29142	Kenora/Keefer															
29143	Keefer Ct			x												
29145	Caroline/Barton															
29146	Stuart St															
29217	Chatham/Fanning															
29230	80 Cameo															
29231	Audrey/East 27th															
29547	Pier 25						x									
29561	Vansitmart/Strathearne		x			x							x	x		

AQI - Air Quality Index
 SO2 - Sulphur Dioxide
 TSP - Total Suspended Particulate
 PM10 - Respirable Particulate
 COH - Soiling Index
 TRS - Total Reduced Sulphur
 O3 - Ozone
 NOx - Nitrogen Oxides
 CO - Carbon Monoxide
 DF - Dustfall
 F - Fluoride
 VOC - Volatile Organics
 PAH - Polynuclear Aromatic Hydrocarbons

4. ANALYSIS OF DATA

4.1 Air Quality Index (AQI)

The AQI is a system by which the public can be informed about air quality on a daily and even hourly basis. The index supplemented the old Air Pollution Index (API) which had been in place since 1970 and which still exists as a subindex of the AQI.

In the AQI, hourly concentrations of sulphur dioxide, soiling index (airborne particles), nitrogen dioxide, carbon monoxide, ozone and reduced sulphur compounds are all converted to a common scale of numbers. In addition to these hourly measurements, 8-hour average levels of carbon monoxide and the API, a 24-hour function of sulphur dioxide and particles are also included as subindices, making a total of 8 potential subindices measured every hour. The official AQI broadcast is the highest subindex at that time.

The AQI scale is classified as follows:

0 - 15	Very Good
16 - 31	Good
32 - 49	Moderate
50 - 99	Poor
100 +	Very Poor

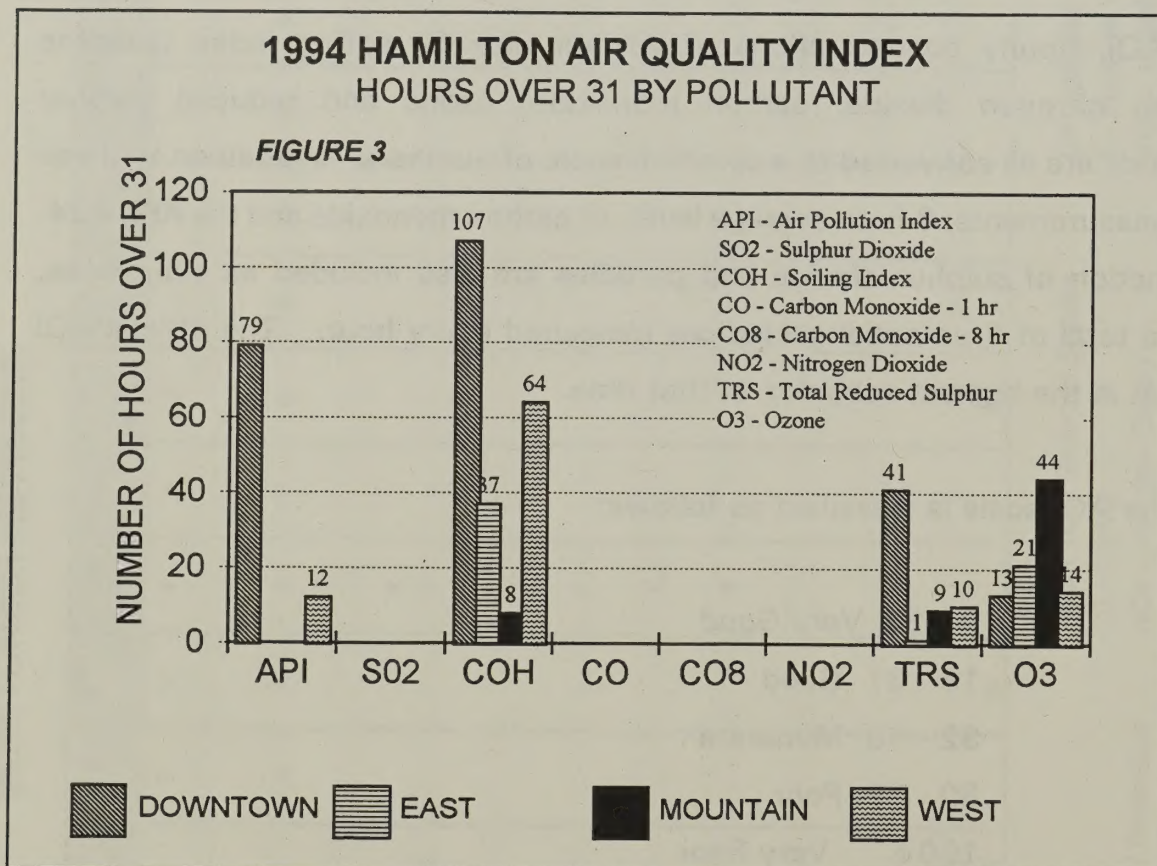
Index levels up to 31 should have little or no effect on people and the environment. Beginning at the moderate level, effects such as odour, vegetation damage and some health effects to sensitive individuals start to occur.

In the poor and very poor categories, these symptoms become more and more acute, such that virtually all people would be hampered in the very poor range.

When moderate levels or higher are measured, public health advisories can be issued to the public along with the actual index number.

Statistics on hourly frequencies for 1994 for each pollutant in the five concentration categories for the four Hamilton stations are presented in Table 2.

Figure 3 graphically displays the numbers of index hours in the Moderate or higher ranges for each station and for each sub-index. As can be seen, suspended



particles (COH) was the most problematic pollutant followed by ozone, the Air Pollution Index and total reduced sulphur. The downtown station had the greatest number of these hours, except for ozone, for which the mountain site was the leader.

TABLE 2
AIR QUALITY INDEX - 1994
HOURLY FREQUENCY DISTRIBUTION

POLLUTANT		0-15 Very Good	16-31 Good	32-49 Moderate	50-99 Poor	100+ Very Poor
29000 HAMILTON DOWNTOWN	SO2	8635	0	0	0	0
	COH	7888	661	107	0	0
	O3	8351	298	13	0	0
	NO2	8654	1	0	0	0
	CO	8318	0	0	0	0
	CO8	8318	0	0	0	0
	TRS	8450	159	39	2	0
	AP1	7128	1412	79	0	0
29105 HAMILTON EAST	SO2	8559	0	0	0	0
	COH	8070	363	37	0	0
	O3	8072	452	20	1	0
	TRS	7441	46	1	0	0
	AP1	7892	605	0	0	0
29114 HAMILTON MOUNTAIN	SO2	8578	0	0	0	0
	COH	8181	51	3	0	0
	O3	7505	738	44	0	0
	NO2	7859	0	0	0	0
	TRS	8276	62	9	0	0
	AP1	8224	397	0	0	0
29118 HAMILTON WEST	SO2	8683	0	0	0	0
	COH	8044	550	64	0	0
	O3	8166	476	14	0	0
	NO2	8420	4	0	0	0
	CO	8694	0	0	0	0
	CO8	8694	0	0	0	0
	TRS	8538	12	10	2	0
	AP1	7751	905	12	0	0

SO2-SULPHUR DIOXIDE
COH-SOILING INDEX
O3-OZONE
NO2-NITROGEN DIOXIDE

CO-CARBON MONOXIDE(1hr)
CO8-CARBON MONOXIDE(8hr)
TRS-TOTAL REDUCED SULPHUR
API-AIR POLLUTION INDEX

4.2 Air Pollution Index

The Hamilton air pollution index (API) continued to be used as a warning system to alert the public to elevated air pollution levels and as a trigger for cutbacks in industrial emissions. It is derived from 24-hour average concentrations of sulphur dioxide and particulate matter. The combination of these two pollutants at elevated levels is indicative of detrimental human health effects. Hourly concentrations of both pollutants are telemetered to a central computer facility in Toronto which then calculates the index each hour, based on the following equations:

$$\text{Downtown API} = 1.47 (16.4 \text{ COH} + 122.9 \text{ SO}_2)^{.92}$$

$$\text{East API} = 2.68 (11.0 \text{ COH} + 122.2 \text{ SO}_2)^{.79}$$

$$\text{West API} = 2.84 (10.8 \text{ COH} + 120.9 \text{ SO}_2)^{.77}$$

$$\text{Mountain API} = 2.68 (11.0 \text{ COH} + 122.2 \text{ SO}_2)^{.79}$$

Where: COH is the 24-hour average soiling index concentration expressed in coefficient of haze units.

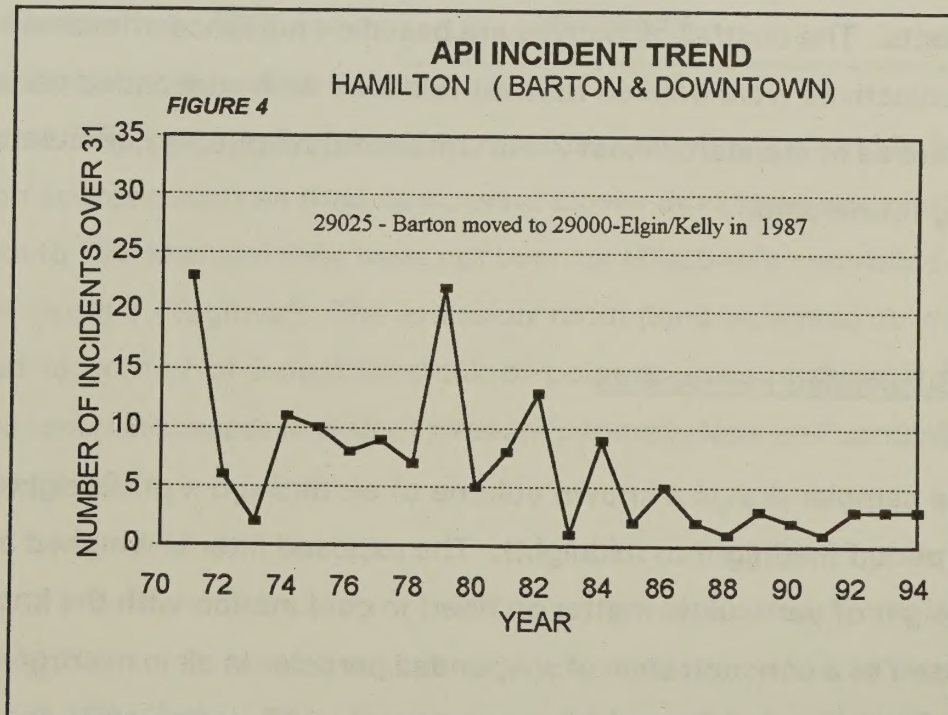
SO₂ is the 24-hour average of sulphur dioxide concentration expressed in parts per million.

No action is taken for readings up to 31. At 32, known as the advisory level, and with a forecast of unfavourable dispersion conditions, major industries in Hamilton are notified and asked to voluntarily curtail certain operations. At an API of 50, cutbacks by these sources become mandatory. These levels are set with a considerable safety margin before health effects to sensitive people would be expected. At 75, further cutbacks would be ordered, and at 100 all sources not essential to public health and safety could be ordered to cease operations.

During 1994, there were three times when the API reached Moderate at the downtown site; occurring February 18-19, June 15-17 and September 22, peaking at 35, 37 and 37 respectively. The other stations recorded almost as high levels with the east end peaking at 20-29, the mountain 15-26 and the west end 26-35 during these incidents. The west site was the only other station to exceed 31 - during the June event.

The incidents were all a result of the classical lake breeze phenomenon, in which a warm southerly air mass was undercut by a cool northeast breeze off a cold Lake Ontario resulting in a temperature inversion.

There used to be a high variability in the numbers of incidents each year, a variability that was weather related, ie. related to the frequency of typical inversion conditions. However, there has been a general decline in the frequency of these incidents (Figure 4) such that since 1987, one to three API incidents occur each year at any one location, mostly at the Downtown site.



4.3 Particulates

There are four types of instruments routinely employed for the measurement of particles, each type relating to a different size range:

- a) Dustfall jars measuring heavy material, generally greater than 10 microns in diameter (one micron is one millionth of a metre).
- b) High volume samplers measuring suspended particulates ranging in size from submicron to 50 microns.
- c) Co-efficient of haze (soiling index) tape samplers measuring mostly fine material - from submicron to about 10 microns.
- d) High volume samples measuring respirable particulates less than 10 microns.

The ambient air quality objectives for suspended particulate are based on visibility and health effects. The dustfall objectives are based on nuisance effects while the soiling index objectives were derived from correlations with suspended particulate data. No objectives or standards exist yet in Ontario for respirable particulates, but they are being formulated.

4.3.1 Total Suspended Particulates

A high volume sampler draws a known volume of air through a pre-weighed filter for a 24 hour period (midnight to midnight). The exposed filter is weighed and the difference (weight of particulate matter on filter) in conjunction with the known air flow is expressed as a concentration of suspended particles in air in micrograms per cubic meter. The objective for a 24-hour average is 120 ug/m³ while the yearly geometric mean objective is 60 ug/m³.

There were 19 hivol stations in 1994 and each ran simultaneously, once every six days, consistent with the practice in other North American jurisdictions. This means that each day of the week is sampled in sequence, i.e. Sunday, next Saturday, next Friday, etc.

Suspended particulate data is summarized in Table 3a and shows a definite gradient of higher concentrations closer to the industrial area.

The overall trend in TSP since 1970 is shown in Figure 5, and displays a steady decline in concentrations.

On average, 1994 levels were 14% less than those of 1988. The trend curve for industrial emissions also shows a decline over this period. While the trends of TSP and emissions are similar, the magnitude

of change is not. TSP has not decreased as much as emissions, probably because other pollution sources such as road dust, wind blown dust from unpaved areas, etc. contribute to TSP also and they have not been as effectively controlled. These emissions are termed "fugitive". The emission reductions achieved to date are mostly related to control of industrial stack or point sources. Industrial fugitive emissions from open processes and stockpiles are generally less well controlled and can contribute to TSP.

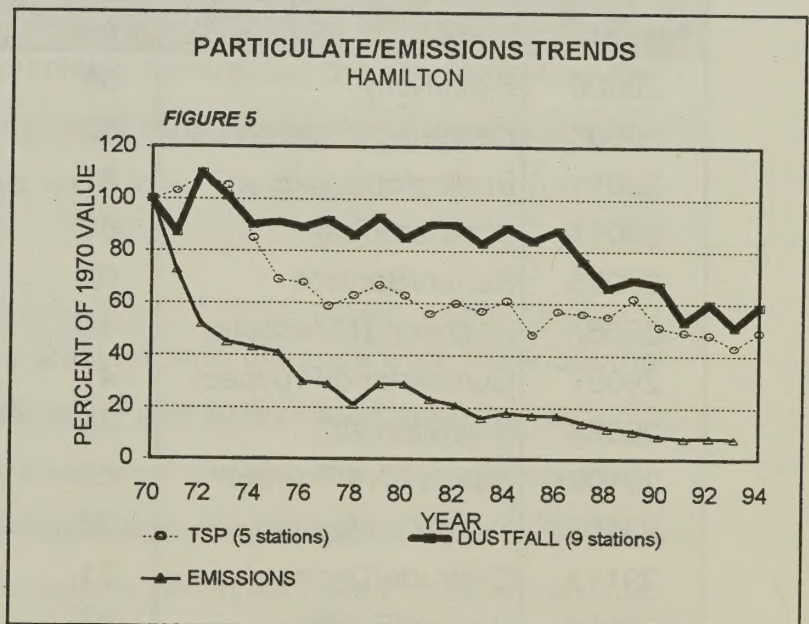


TABLE 3a
SUSPENDED PARTICULATES

Ontario Objectives: 120 ug/m³ (24 hr)
60 ug/m³ (1 yr geo.mean)

micrograms per cubic metre

STATION NUMBER	LOCATION	GEOMETRIC MEAN			MAX 1994	% SAMPLES > 120 (1994)
		1992	1993	1994		
29000	Elgin/Kelly	59	53	60	204	9
29009	Kenilworth/Roxborough	50	45	50	129	4
29011	Burlington/Leeds	81	81	75	172	14
29017	Chatham/Frid	69	57	68	158	11
29025	Barton/Sanford	62	56	60	146	9
29067	Hughson N/Macauley	44	40	40	83	0
29087	Cumberland/Prospect	41	47	54	117	0
29098	Bay/Main W	45	40	44	101	0
29102	Beach Blvd/Towers	52	57	66	183	9
29105	Nash/Kentley	38	41	41	95	0
29113	Gertrude/Depew	71	63	71	157	11
29114	Vickers/E 18th	37	40	39	83	0
29118	Main W/Hwy 403	44	37	39	76	0
29119	Morley/Parkdale	63	59	72	152	8
29122	Dundurn/York	37	35	36	77	0
29124	Buchanan Park School	41	37	37	83	0
29130	Ewen/Whitney	29	30	35	65	0
29135	Albright/Mt Albion	33	32	33	81	0
29143	Keefer Ct		58	59	138	5

Metals, Sulphate/Nitrate

The hi-vol filters of six stations were to be analyzed for seven metals, sulphates and nitrates (Table 3b), but problems with laboratory equipment delayed analysis of the 1994 samples and data were unavailable for this report. The data should be similar to 1993 results, so discussion using those results follow.

Concentrations of nickel, cadmium, lead and vanadium showed very low concentrations which did not vary appreciably throughout the city indicating that they were background levels. Concentrations of lead and nickel were highest at industrial station 29011, but the levels were low. The 24-hour criteria for these metals were easily met.

Concentrations of chromium showed a gradient with distance from the industrial area. However, even the highest levels were well below acceptable levels.

Iron and manganese concentrations were elevated and also showed a gradient with distance from the industrial area. Manganese concentrations were often well above general background levels, but below guidelines which are based on health effects. Iron measurements are reported as iron as opposed to the objective which is for iron oxide. A target iron level of 17 ug/m^3 was exceeded once at 29011 - Burlington/Leeds in 1993. The iron oxide objective is based on soiling effects.

The sulphate/nitrate components measured at 5 stations comprised a large portion of the measured particulate matter. These constituents are largely by-products of major high temperature fuel combustion sources and can travel hundreds of miles from their source. The concentrations in Hamilton showed a small gradient from the industrial area in 1993, indicating some contribution from local industries. Most of these acid aerosols are due to long range transport from distant sources. On days of elevated sulphate concentration, levels outside the city in Haldimand/Norfolk and Niagara are as high or higher than those in Hamilton and the five Hamilton stations tend to show comparable levels to each other. Winds on these occasions are from the southwest. The sulphate/nitrate components are known to be a factor in reduced visibility and are often responsible for the

TABLE 3b
CONSTITUENTS IN SUSPENDED PARTICULATE
micrograms per cubic metre

YEAR	No. of Samples	2.0		1.5		25 (Ferric Oxide)		2.0		2.5	
24 hr criterion											
		Cadmium		Chromium		Iron		Lead		Manganese	
		Geo Mean	Max	Geo Mean	Max	Geo Mean	Max	Geo Mean	Max	Geo Mean	Max
29011 - Burlington/Leeds											
1994											
1993	50	0.001	0.009	0.047	0.16	3.9	18.0	0.08	0.46	0.26	1.16
1992	59	0.001	0.006	0.030	0.09	3.8	23.3	0.09	0.34	0.28	1.16
29025 - Barton/Sanford											
1994											
1993	56	0.000	0.006	0.016	0.13	1.7	13.0	0.03	1.10	0.13	0.78
1992	53	0.000	0.006	0.010	0.23	1.9	12.9	0.04	0.37	0.17	0.79
29067 - Hughson/Hunter											
1994											
1993	55	0.000	0.006	0.006	0.04	0.7	6.7	0.01	0.07	0.04	0.28
1992	45	0.000	0.002	0.006	0.04	1.0	3.3	0.02	0.09	0.06	0.23
29098 - Bay/Main											
1994											
1993	53	0.000	0.002	0.008	0.09	0.8	9.0	0.01	0.09	0.05	0.59
1992	56	0.000	0.001	0.009	0.04	1.1	7.9	0.02	0.18	0.08	0.50
29102 - Beach Blvd											
1994											
1993	46	0.000	0.009	0.014	0.05	1.9	6.2	0.02	0.11	0.12	0.34
1992	51	0.000	0.002	0.006	0.03	1.5	5.8	0.02	0.24	0.09	0.39
29114 - Vickers/East 18th											
1994											
1993	52	0.000	0.002	0.006	0.05	0.6	3.6	0.02	0.10	0.04	0.29
1992	58	0.000	0.001	0.007	0.05	0.6	6.2	0.01	0.17	0.05	0.23

TABLE 3b
CONSTITUENTS IN SUSPENDED PARTICULATE
micrograms per cubic metre

24 hr criterion 2.0 2.0

YEAR	No. of Samples	Nickel		Vanadium		Nitrate		Sulphate	
		Geo Mean	Max	Geo Mean	Max	Geo Mean	Max	Geo Mean	Max
29011 - Burlington/Leeds									
1994									
1993	50	0.008	0.021	0.01	0.04	3.1	17.7	11.2	38.1
1992	59	0.007	0.030	0.01	0.05	3.7	13.7	11.2	26.1
29025 - Barton/Sanford									
1994									
1993	56	0.005	0.040	0.01	0.06	3.0	14.4	9.5	20.9
1992	53	0.007	0.040	0.01	0.13	3.6	10.9	11.4	24.6
29067 - Hughson/Hunter									
1994									
1993	55	0.003	0.010	0.00	0.02				
1992	45	0.005	0.010	0.01	0.02				
29098 - Bay/Main									
1994									
1993	53	0.003	0.020	0.01	0.06	3.5	14.3	9.1	22.7
1992	56	0.005	0.010	0.01	0.03	4.2	13.1	9.7	24.4
29102 - Beach Blvd									
1994									
1993	46	0.005	0.022	0.01	0.06	2.8	12.0	11.2	19.0
1992	51	0.006	0.020	0.01	0.04	3.6	12.2	11.2	28.8
29114 - Vickers/East 18th									
1994									
1993	52	0.003	0.030	0.01	0.05	3.4	11.4	8.9	25.0
1992	58	0.005	0.010	0.01	0.03	3.6	10.4	9.3	24.0

widespread haze observed in Hamilton during southerly winds. There are occasions however, during northeast wind days when stations close to the industries read higher sulphate/nitrate, indicating some local industrial contributions. These events are not as elevated as the southwest wind case though.

It should be noted that the sulphate/nitrate analyses are subject to some error due to the measurement methodology. For this reason the data should be primarily used for evaluation of trends rather than use of the actual values. Tests with a new filter medium indicate that the glass fibre filter can cause as much as 8 ug/m^3 on average of spurious sulphate/nitrate formation from gaseous sulphur dioxide and nitrogen oxides. It is possible that the marginally higher industrial area sulphate levels are related to this error, since gaseous sulphur dioxide and nitrogen oxide levels are somewhat higher there.

Suspended Particulates Analysis

A contour map of suspended particulate concentrations (yearly average) is given in Figure 6a. It can be seen that the majority of the city met the yearly objective of 60 ug/m^3 . Concentrations were only elevated close to the industrial area. Beyond this area, concentrations were fairly uniform across the city. Figure 6b further illustrates the improvement on a spatial basis. Although the 1994 results do not continue the long term trend, the figure displays the decreasing area covered by the 60 micrograms per cubic metre contour from year to year.

It should be realized that these contour maps of concentrations are a very general picture of city wide air quality. Local influences affect some of the stations, and several more stations would be required to fill in some gaps.

Figure 6a reflects long term average conditions. A different situation exists during inversion conditions, with poor dispersion, when pollution from all sources, including traffic and industry, can accumulate and will contribute to the totals.

FIGURE 6a

ISOPLETHS OF 1994
SUSPENDED PARTICULATE
GEOMETRIC MEANS

MICROGRAMS PER CUBIC METRE

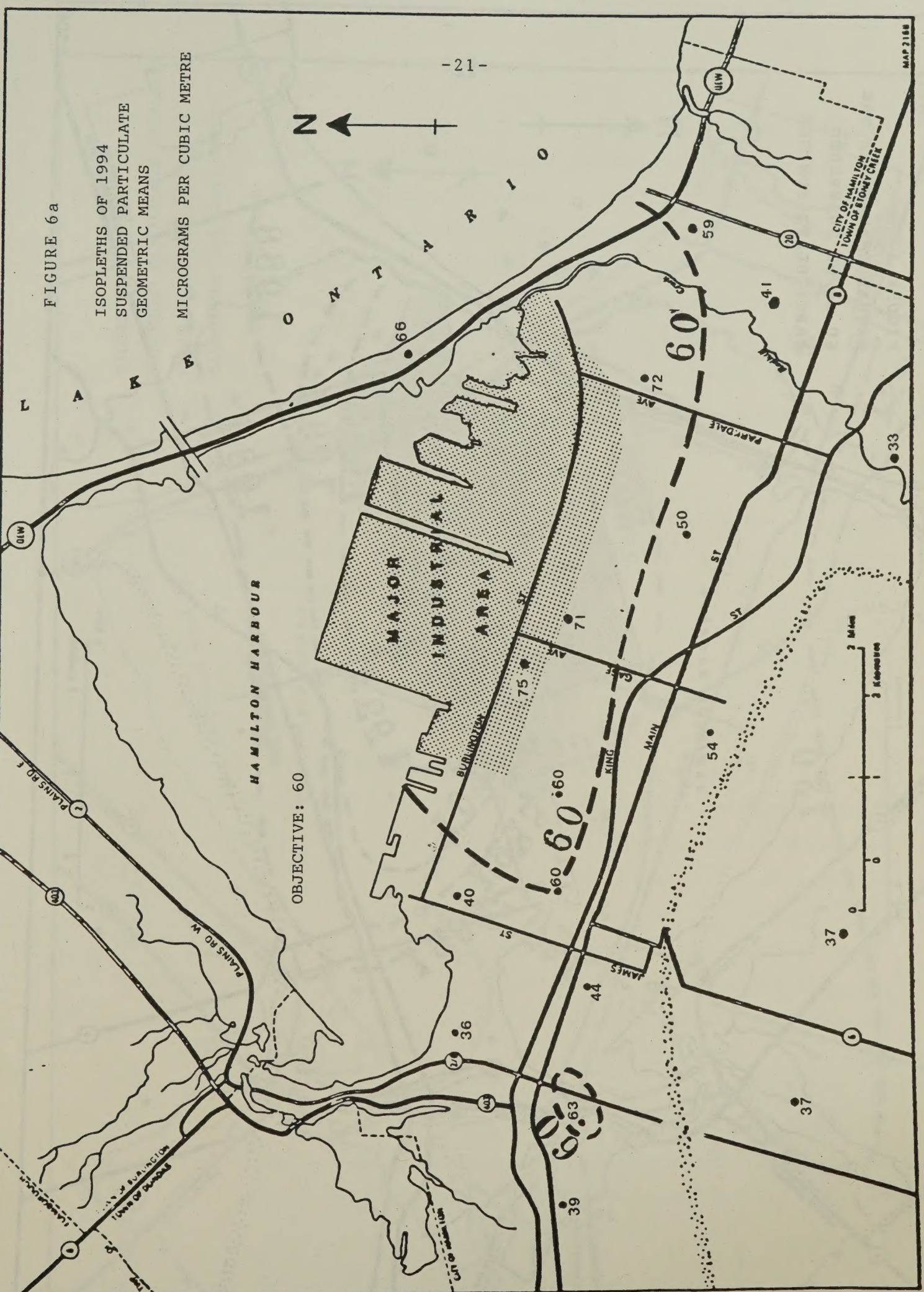


FIGURE 6b
ANNUAL CHANGES IN THE
60 ug/m³ SUSPENDED
PARTICULATE CONTOUR

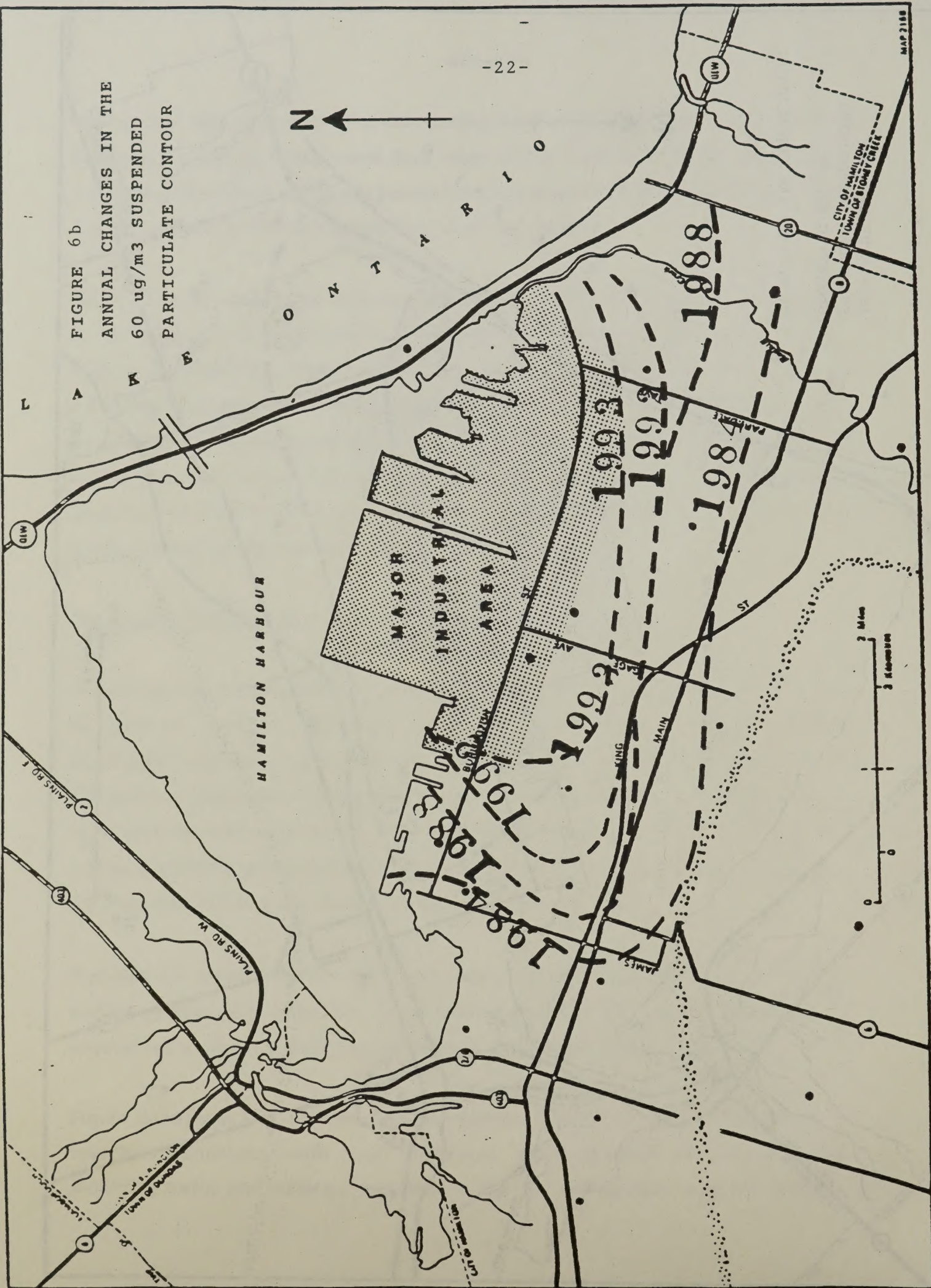


FIGURE 7

SUSPENDED PARTICULATE ISOPLETHS

MARCH 26, 1993

MICROGRAMS PER CUBIC METRE

OBJECTIVE: 120

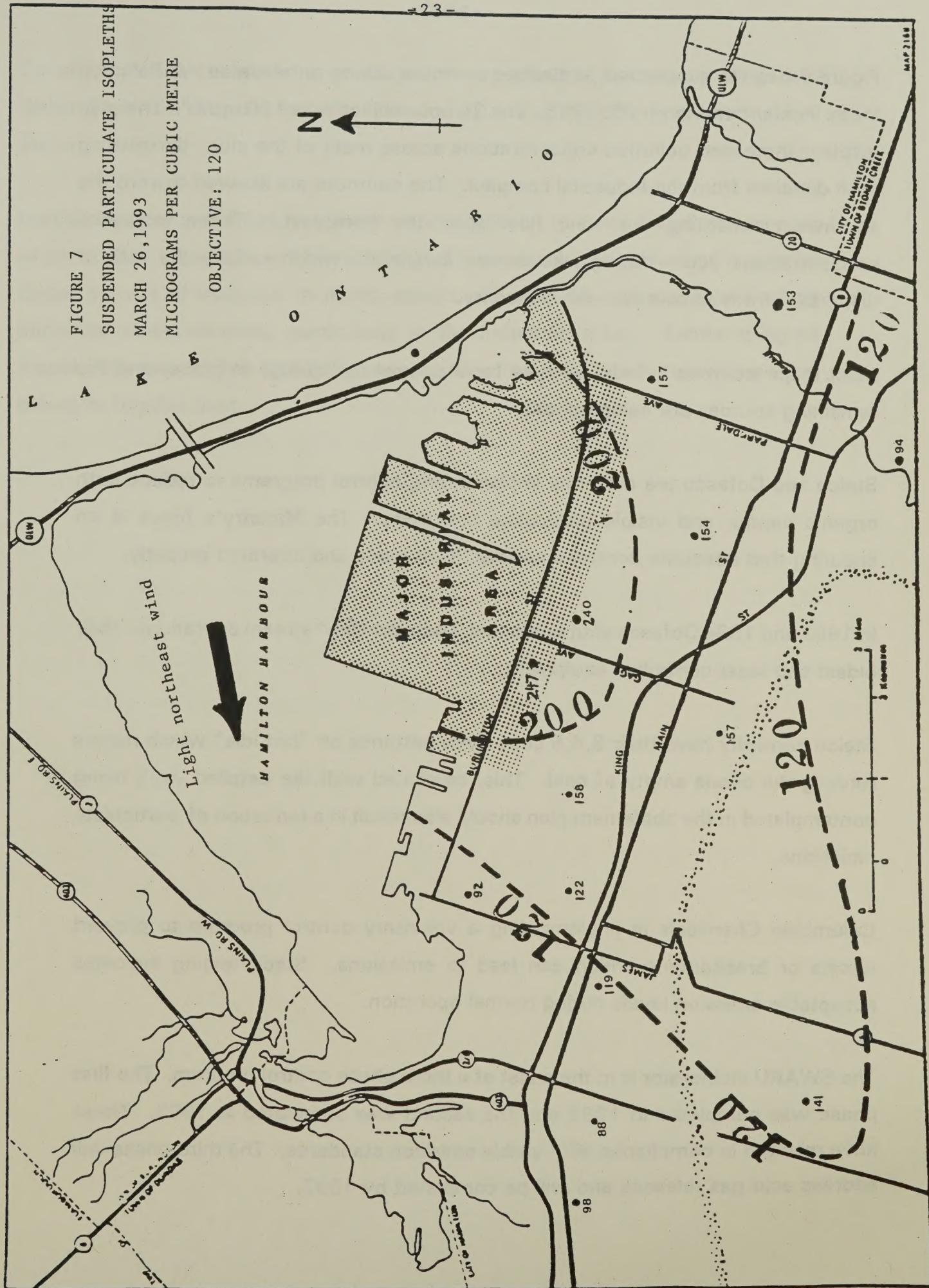


Figure 7 depicts suspended particulate contours during an elevated Air Pollution Index incident on March 26, 1993. The 24 hour objective is 120 ug/m^3 . The map displays increased pollution concentrations across most of the city, diminishing with distance from the industrial complex. The contours are skewed toward the southwest reflecting the wind flow from the northeast. These increased concentrations occur during lake breeze inversions which reduce the rate of dispersion from all sources within the city.

Most major sources in industry now have control technology in place, and the remaining sources are being abated.

Stelco and Dofasco are currently implementing control programs to reduce both organic vapour and visible particulate emissions. The Ministry's focus is on ensuring that adequate control equipment is in place and operated properly.

In 1993 and 1994 Dofasco shut down their "number One" stream operations - their oldest and least controlled equipment.

Stelco currently have their 3,4,5 coke oven batteries on "hot idle" which means running the ovens empty of coal. This, combined with the detailed work being contemplated in the abatement plan should also result in a reduction of particulate emissions.

Columbian Chemicals is implementing a voluntary control program to prevent upsets or breakdowns which can lead to emissions. Stack testing indicates acceptable emission levels during normal operation.

The SWARU incinerator is in the midst of a three phase control program. The first phase was completed in 1992 and the second was completed in 1993. These have resulted in compliance with visible emission standards. The third phase will address acid gas releases and will be completed by 1997.

Canada Pipe has completed upgrading of their particulate emission controls and Slater Steel did likewise, but the Ministry will require further improvements at Slater.

Inside company properties, programs are in operation to control roadway sources of particulate. Roads have been paved and road cleaning is performed regularly. Better control of track-out to public streets still appears necessary, as well as improved street cleaning, particularly in the industrial area. Landscaping of industrial properties has also been ongoing for some time in order to reduce wind blown or fugitive dust.

4.3.2 Respirable Particulate (PM10)

Respirable particulate is defined as particles less than 10 microns in diameter. A micron is one millionth of a metre. These particles can penetrate into the human lung and research has shown a correlation between health effects and concentrations of these particles.

The measurement methodology is similar to that for suspended particulates, utilizing a high volume sampler outfitted with a special size fractionating head, which permits the sampling of particles 10 microns and less in size. Quartz filters are used instead of glass fibre. As mentioned, standards do not exist yet in Ontario, but are being formulated.

The measurements were begun in 1991 at four sites and tended to mirror the suspended particulate results which were measured alongside. Data are summarized in Table 3c. In past years there was not a great variation in concentrations between the three lower city sites, but in 1994 the industrial zone station 29313 showed an increase returning to pre-1993 levels. This site showed the highest mean at 34 ug/m³. The mountain site 29324 had the lowest at 20 ug/m³. Figure 8 gives a visual indication of the spatial variations.

The respirable particulate fraction generally comprised between 40-50% of the total suspended particulate loadings, but the mountain site which had the lowest TSP average, held the greatest percentage of respirable particulate - 54% in 1994, all of which was similar to 1993 results.

Metals, Sulphate Content in Respirable Particulate

The PM10 filters were to be analyzed for a scan of 25 elements, but as mentioned earlier, laboratory equipment problems delayed analysis of the 1994 samples. The following discussion relates to the 1993 results.

The most notable observation of the respirable particulate contents was that most of the sulphate concentrations observed in suspended particulates occurred in the respirable fraction. This is due to the acid haze phenomenon. The acid sulphate particles in the air tend to occur in small particle sizes because they are formed by gas to particle chemical reactions in the atmosphere as sulphur dioxide travels north from the US or from local emissions.

In the case of other elements such as iron and manganese, there seemed to be a pattern of increasing respirable fractions further from the industrial zone (although actual concentrations were lower). For instance, downtown, these metals comprised 55% respirable. Close to the industries, however, the Beach station averaged 25-35% and near Burlington Street, stations also averaged 25-35% respirable. This indicates that industrial emissions are mainly comprised of larger particles which do not travel as far, as shown by the dustfall results. However, there was a fair amount of variation from site to site and element to element. The elemental data from three of the PM10s (besides Beach) had to be compared to other nearby hivols where metal scans were performed. Different site influences may cause some of the variations observed.

TABLE 3c
RESPIRABLE PARTICULATES

PARTICULATE LESS THAN 10 MICRONS IN DIAMETER

micrograms per cubic metre

YEAR	NUMBER OF SAMPLES	GEOMETRIC MEAN	MAXIMUM 24 HR
29300 - Elgin/Kelly			
1994	54	26	96
1993	57	22	97
1992	57	26	80
1991	56	26	70
29302 - Beach Blvd			
1994	54	25	65
1993	53	27	130
1992	54	22	71
1991	56	29	100
29313 - Gertrude/Depew			
1994	53	34	90
1993	49	26	104
1992	55	32	110
1991	56	33	86
29324 - Laurier/Columbia			
1994	34	20	39
1993	53	18	79
1992	35	22	72

1994 RESPIRABLE PARTICULATE

AVG(MAX)

UG/M3

FIGURE 8

25(65)

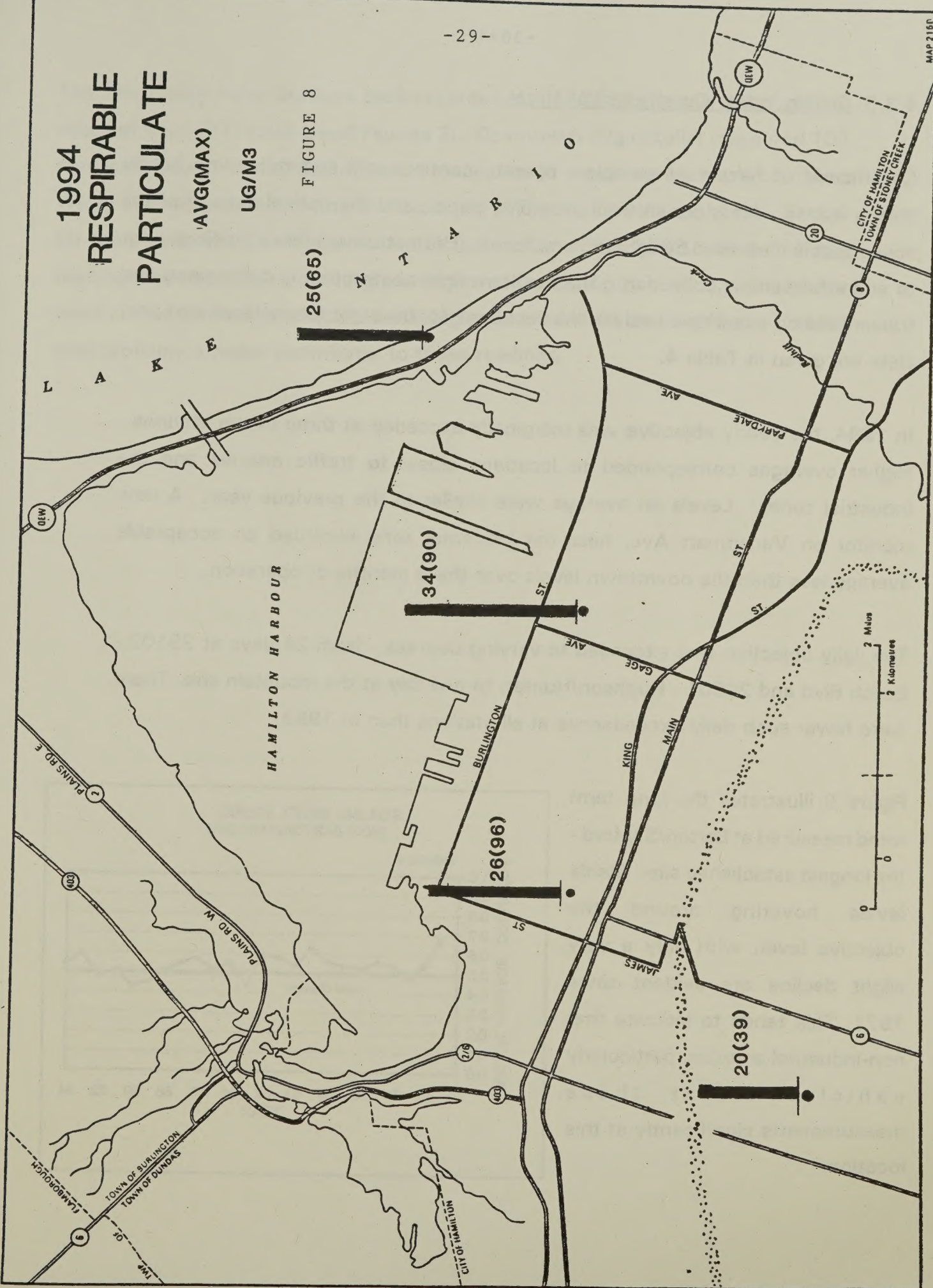
34(90)

26(96)

20(39)

HAMILTON HARBOUR

L A K E
O N T A R I O



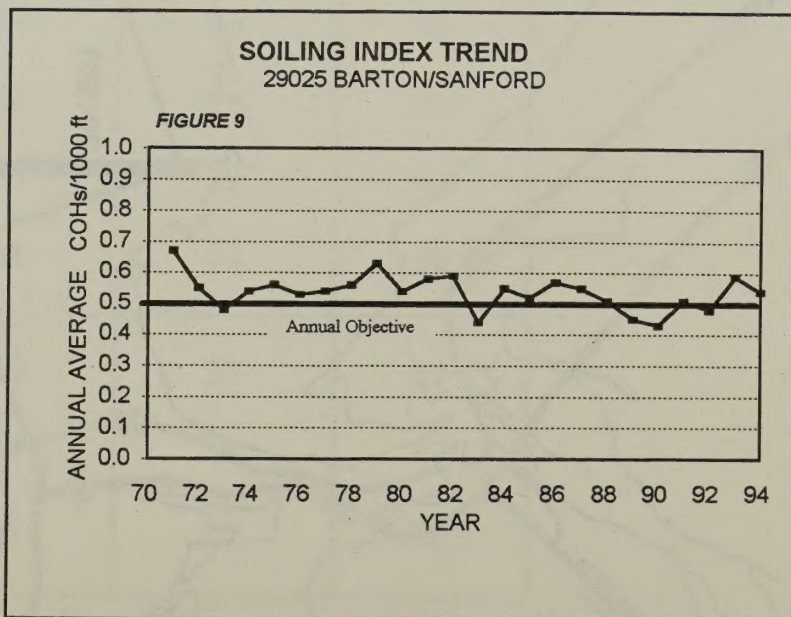
4.3.3 Soiling Index (Co-efficient of Haze)

Co-efficient of haze tape samplers operate continuously and determine hourly soiling values. Air is drawn through a filter paper, and the optical density of the soiled spot is measured by light transmittance. The instrument takes readings prior to and after sample collection. The resultant light obstruction is determined and transmitted on a real time basis to the data bank for the eight telemetered stations. Data are given in Table 4.

In 1994, the yearly objective was marginally exceeded at three of the stations. Higher averages corresponded to locations closer to traffic arteries and the industrial zone. Levels on average were similar to the previous year. A new monitor on Vansitmart Ave, near the industrial zone recorded an acceptable average less than the downtown levels over the 3 months of operation.

The daily objective was exceeded to varying degrees - from 24 days at 29102 - Beach Blvd and 29001 - Hughson/Hunter, to one day at the mountain site. There were fewer such daily exceedances at all stations than in 1993.

Figure 9 illustrates the long term trend measured at Barton/Sanford - the longest established site. Stable levels hovering around the objective level, with only a very slight decline are evident since 1971. This tends to indicate that non-industrial sources, particularly vehicles affect these measurements significantly at this location.



The Air Quality Index stations each recorded hourly COH levels in the moderate range of the AQI (Tables 2 and Figures 3). Downtown (Elgin/Kelly) measured 107 moderate hours, East (Nash/Kentley) measured 37 moderate hours; West (Main West) 64 moderate hours and the mountain (Vickers) 3 moderate hours. Except for the downtown site, these were all improvements from 1993. Many of these readings occurred during morning rush hours and/or during inversions, although the west station tended to measure some higher levels in late evening hours. Traffic was probably a major contributor to these readings.

TABLE 4
SOILING INDEX

COHs/1000 linear feet of air			
YEAR	ANNUAL AVERAGE	MAXIMUM 24 HOUR	Days Above 24 hr Objective
29000 - Elgin/Kelly			
1994	0.47	1.8	17
1993	0.48	1.7	19
1992	0.45	1.8	14
29001 - Hughson/Hunter			
1994	0.54	2.8	24
1993	0.56	2.2	34
1992	0.39	1.8	7
29025 - Barton/Sanford			
1994	0.54	2.2	21
1993	0.59	2.0	34
1992	0.48	1.6	13
29102 - Beach Blvd			
1994	0.59	2.1	24
1993	0.56	1.8	27
1992	0.44	1.2	3
29105 - Nash/Kentley			
1994	0.47	1.7	6
1993	0.50	2.0	12
1992	0.35	1.4	2
29114 - Vickers/East 18th			
1994	0.28	1.2	1
1993	0.31	1.6	6
1992	0.30	1.1	1
29118 - Main West			
1994	0.38	1.8	13
1993	0.42	1.7	14
1992	0.41	1.6	14
29561 - Vansitmart Ave.			
1994	0.38*	1.8	13

Ontario Objectives: 1.0 COHs/1000 ft (24 hour)
0.5 COHs/1000 ft (annual average)

* Oct -Dec only

4.3.4 Dustfall

Dustfall is that material which settles out of the atmosphere by gravity. It is collected in plastic containers during a 30 day exposure time. The collected material is weighed and expressed as a deposition rate of grams/square metre/30 days. The significance of observations is restricted to relatively local areas and dustfall objectives are based on visible deposit of dust rather than health effects.

Dustfall levels in 1994 (Table 5a) increased by 9% from 1993, but the overall trend is downward as shown by Figure 5. The 1994 levels were 30% less than those measured in 1986. Still, some of the lower city exceeded the objective. Figure 10a depicts dustfall isopleths, and shows that a portion of the lower city near the industrial area was encompassed by the 4.5 grams/m²/30 days contour which represents the annual objective. Conditions in parts of this area were poor. As with the suspended particulate contour maps, the dustfall contour map in Figure 10 is not strictly a definitive representation of conditions city wide. Local influences affect some of the stations and the measurement is imprecise. One small contour drawn in indicates that particular station was subject to local influences, unrepresentative of general patterns.

Figure 5 displays the recent dustfall improvements following many years when levels remained virtually unchanged throughout the 1970's and 1980's. The absence of change in dustfall over the earlier years was surprising given the reductions in industrial process emissions and the correspondingly large reduction in suspended particulate concentrations noted in the same graph. Fugitive dust sources such as road dust, stock piles, unpaved areas, vehicle emissions, etc. are probably important in explaining this observation. The recent reductions represent the first significant improvement in dustfall levels in many years.

Five dustfall stations were routinely analyzed for a scan of 10 metals (Table 5b). The most prominent metals were iron and manganese followed by copper and zinc, each showing a strong gradient with distance from the industrial zone with the exception of copper and zinc which for unknown reasons showed higher averages on the mountain at 29230.

Only one of the metals has an objective - lead, and it was not exceeded at any of the stations. Lead in dustfall varied little across the City, similar to the pattern found for suspended particulates. The metals cadmium, cobalt, chromium, nickel and vanadium did likewise.

Two new stations (29145 and 29146) were placed near B&M Metals on Caroline St. N., a furnacing facility which includes some lead smelting. Concerns were expressed regarding lead emissions so samples were analyzed for lead. The averages are shown in Tables 5a and 5b. There was one total dustfall exceedance at each station, in different months. The 29145 station was immediately adjacent to the company and recorded higher than normal lead levels compared to both the city as a whole and the control site 29146. Therefore, the company does appear to have a small localised lead impact, however, the lead concentrations were far below the monthly objective.

The dustfall improvements in recent years may be partly due to the economic recession, which led to reduced production levels. However, there have been numerous abatement efforts as well. City staff have modified road cleaning practices. Industry has continued to control fugitive dust emissions by the use of sealants, road washing, landscaping etc. Past measurements on company properties indicated that fugitive dust emissions were considerable. There have also been improvements in control of industrial point sources and apartment incinerators were banned in 1989. All of the above control efforts must be maintained and expanded to achieve further improvements. These may include measures to reduce dirt track out onto streets and increased planting of vegetation.

Ground cover vegetation reduces blow off of dust, while trees reduce ground level wind speed and filter dust from the air. Continued efforts by both industry and the

municipality will be necessary if objectives are to be attained in the lower city.

Dustfall and TSP are also related to visible emissions from industrial sources. In 1994, six charges were brought against major companies for visible emission violations. Partially as a result of these charges, the companies entered into voluntary compliance plans to address visible emissions. At certain sources, these plans are clearly resulting in improvements. At others, particularly Stelco coke ovens, improvement is not evident. The Ministry is considering mandatory abatement for this and other sources

In January 1995, the Minister of the Environment and Energy met with senior management of three local companies primarily responsible for visible emissions in Hamilton. As a result of that meeting, a multi-stakeholder committee has been established to deal with, as part of its mandate, visible emissions from industrial sources. This Remedial Action Plan approach is similar to that taken to improve water quality in Hamilton Harbour and is expected to deliver long term sustainable air quality improvement in the City of Hamilton.

TABLE 5a
DUSTFALL

Ontario Objectives: 7.0 g/m²/30 days (1 month)
4.5 g/m²/30 days (1 year average)

grams / square metre/ 30 days

STATION NUMBER	LOCATION	AVERAGE			MAX 1994	No. of Months > 7.0 (1994)
		1992	1993	1994		
29001	Hughson/Hunter	4.3	4.5	5.7	10.1	1
29006	Queenston Rd	4.1	3.2	3.5	5.7	0
29009	Kenilworth/Roxborough	4.3	3.0	3.8	6.9	0
29010	Burlington/Ottawa	11.1	9.2	12.1	17.4	8
29011	Burlington/Leeds	8.6	7.8	9.5	12.5	9
29012	Burlington/Wellington	5.2	5.0	6.1	14.0	2
29217	Chatham/Fanning	3.6	5.0	3.2	6.0	0
29025	Barton/Sanford	7.0	4.4	4.5	6.2	0
29230	Cameo Ave	4.7	4.4	2.5	3.8	0
29231	Audrey/East 27th	4.2	3.0	4.0	11.0	2
29036	Roosevelt/Beach Rd	12.2	11.9	11.9	14.4	7
29044	Wark/Beach Blvd	7.8	5.4	5.7	11.6	1
29082	Leaside Rd	7.1	5.1	5.0	10.3	1
29084	Rembe/Beach Blvd	7.0	7.7	8.5	27.2	3
29102	Beach Blvd/Towers	4.3	3.5	4.5	6.7	0
29142	Kenora/Keefer	7.9	6.3	6.7	11.6	2
29143	Keefer Ct	3.9	3.5	4.9	15.5	2
29145	Caroline/Barton			5.3	8.2	1
29146	Stuart St			3.5	9.1	1

TABLE 5b
DUSTFALL METALS CONTENT

grams/square metre/30 days

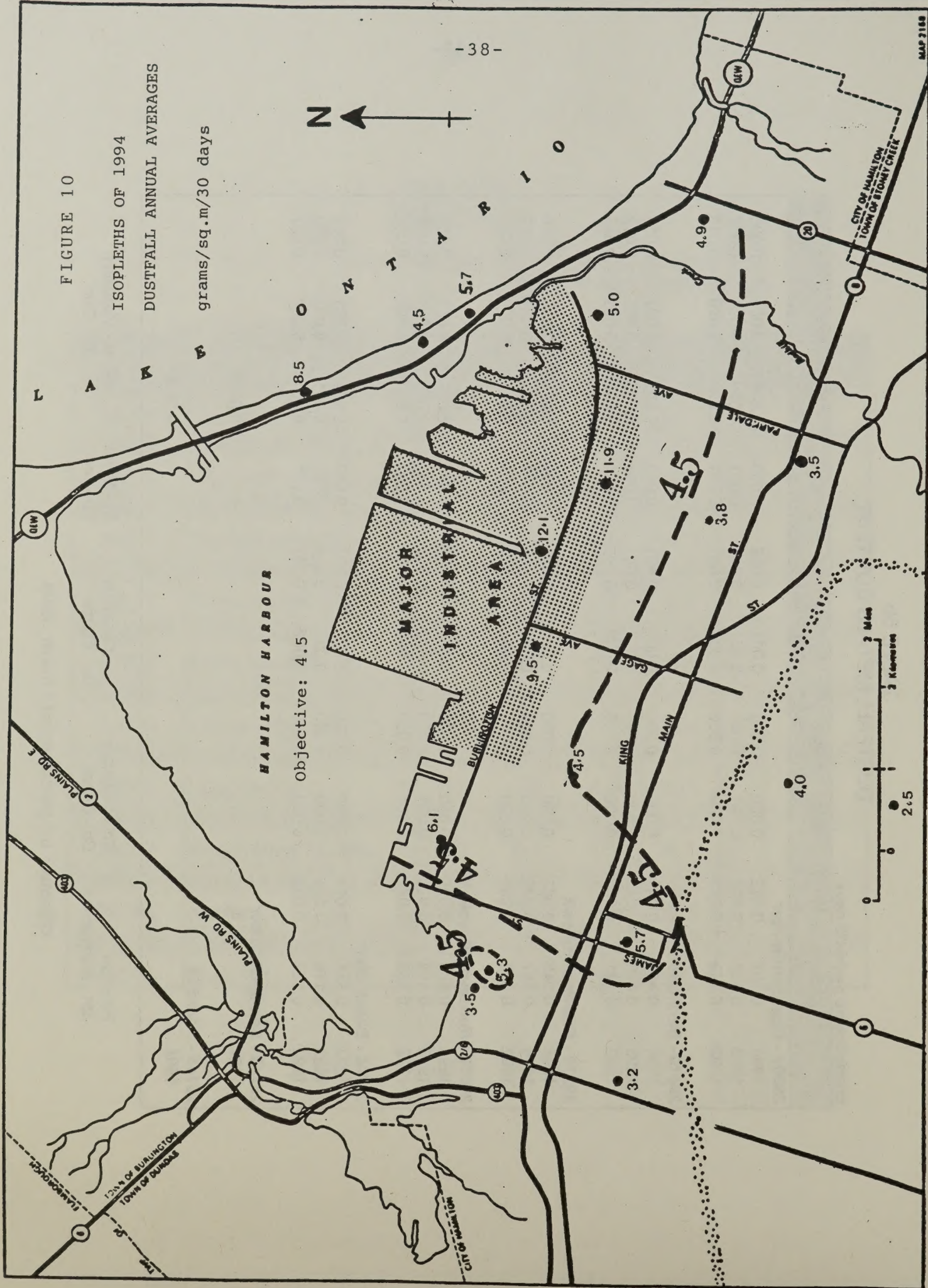
	Fe	Mn	Cd	Co	Cr	Cu	Ni	Pb	V	Zn
YEARLY AVERAGES										
29001 - Hughson/Hunter										
1994	0.151	0.012	0.000	0.000	0.001	0.002	0.000	0.002	0.000	0.005
1993	0.152	0.007	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.006
1992	0.109	0.009	0.000	0.000	0.001	0.001	0.001	0.002	0.000	0.010
29010 - Burlington/Ottawa										
1994	0.483	0.041	0.000	0.000	0.002	0.001	0.000	0.003	0.001	0.015
1993	0.490	0.016	0.000	0.001	0.002	0.001	0.001	0.002	0.001	0.012
1992	0.521	0.036	0.000	0.000	0.002	0.002	0.001	0.003	0.001	0.042
29230 - Camden/Mohawk										
1994	0.045	0.003	0.000	0.000	0.000	0.006	0.000	0.001	0.000	0.016
1993	0.087	0.002	0.000	0.000	0.000	0.007	0.001	0.001	0.001	0.012
1992	0.066	0.005	0.000	0.000	0.001	0.014	0.001	0.001	0.000	0.027
29036 - Roosevelt/Beach Rd										
1994	0.383	0.038	0.000	0.000	0.001	0.003	0.000	0.003	0.001	0.025
1993	0.455	0.020	0.001	0.000	0.002	0.003	0.001	0.003	0.001	0.025
1992	0.489	0.043	0.001	0.000	0.002	0.006	0.001	0.004	0.001	0.031
29102 - Beach Blvd										
1994	0.145	0.014	0.000	0.000	0.001	0.001	0.000	0.001	0.001	0.005
1993	0.119	0.004	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.007
1992	0.132	0.009	0.000	0.000	0.002	0.001	0.001	0.001	0.001	0.007
29145 - Caroline/Barton										
1994								0.029		
29146 - Stuart St										
1994								0.002		

Fe - Iron
Mn - Manganese
Cd - Cadmium
Co - Cobalt
Cr - Chromium
Cu - Copper
Ni - Nickel
Pb - Lead
V - Vanadium
Zn - Zinc

Objective: 0.1 g/m²/30 days (1 month - lead)

FIGURE 10

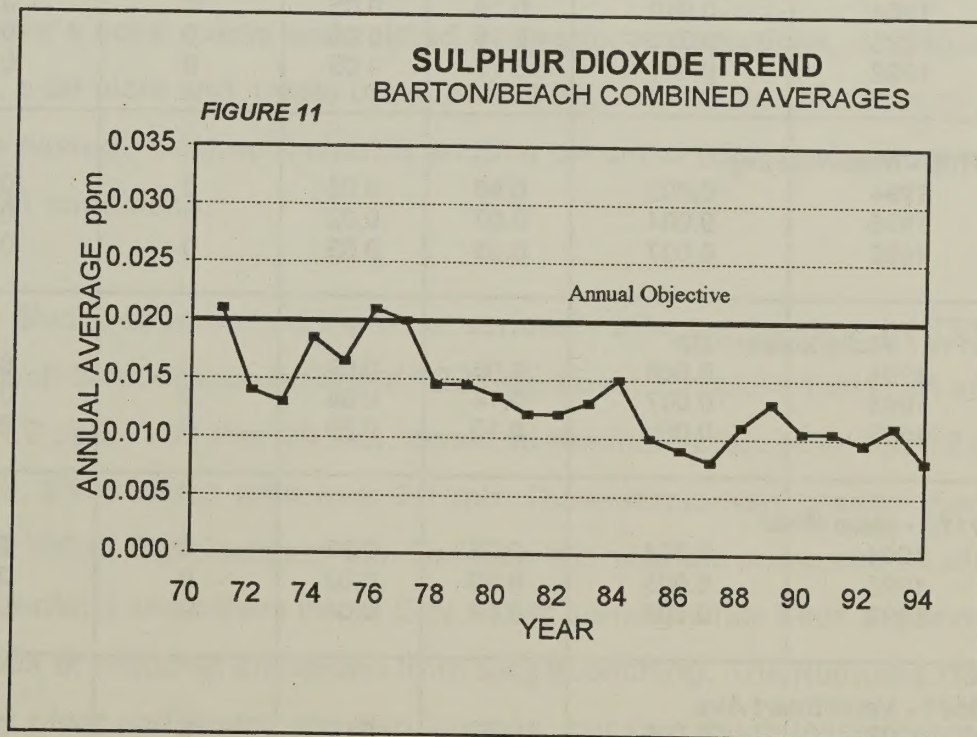
ISOPLETHS OF 1994
DUSTFALL ANNUAL AVERAGES
grams/sq.m/30 days



4.4 Sulphur Dioxide

Most sulphur dioxide (SO₂) emissions in Hamilton stem from industrial sources. A smaller portion is accounted for by fuel burning in domestic space heating. Data for seven stations are summarized in Table 6, which lists objectives based on vegetation damage (hourly and yearly) and health effects (daily).

Sulphur dioxide trends from the two oldest stations are illustrated in Figure 11. Stable levels are evident in recent years. In 1994, as in the past several years, the concentrations were acceptable based on the yearly, daily and hourly objectives. All readings at all four AQI stations fell in the Very Good range of the AQI.



Sulphur dioxide generally shows a gradient with distance from the industrial zone, with the highest average (.010 ppm) measured at the Beach site (downwind of prevailing winds), while lower levels were recorded at the east end (.003) and downtown (.005). A new station on Vansitmart Ave., near the industrial zone measured a low average (.006) over the five months of its operation with no exceedances of guidelines.

TABLE 6
SULPHUR DIOXIDE

parts per million

YEAR	ANNUAL AVERAGE	MAXIMUM		No. Times Over Objective	
		1 hr	24 hr	1 hr	24 hr
29000 - Elgin/Kelly					
1994	0.005	0.09	0.03	0	0
1993	0.006	0.10	0.03	0	0
1992	0.007	0.13	0.03	0	0
29025 - Barton/Sanford					
1994	0.006	0.13	0.04	0	0
1993	0.009	0.11	0.04	0	0
1992	0.008	0.14	0.04	0	0
29102 - Beach Blvd					
1994	0.010	0.16	0.05	0	0
1993	0.013	0.15	0.05	0	0
1992	0.011	0.15	0.05	0	0
29105 - Nash/Kentley					
1994	0.003	0.06	0.02	0	0
1993	0.004	0.07	0.02	0	0
1992	0.007	0.08	0.03	0	0
29114 - Vickers/East 18th					
1994	0.006	0.08	0.04	0	0
1993	0.007	0.14	0.04	0	0
1992	0.006	0.10	0.03	0	0
29118 - Main West					
1994	0.004	0.08	0.03	0	0
1993	0.005	0.09	0.02	0	0
1992	0.006	0.09	0.04	0	0
29561 - Vansitmart Ave.					
1994 (5 months)	0.006	0.09	0.02	0	0

Ontario Objectives: .25 ppm (1 hour)
.10 ppm (24 hour)
.02 ppm (annual average)

4.5 Total Reduced Sulphur

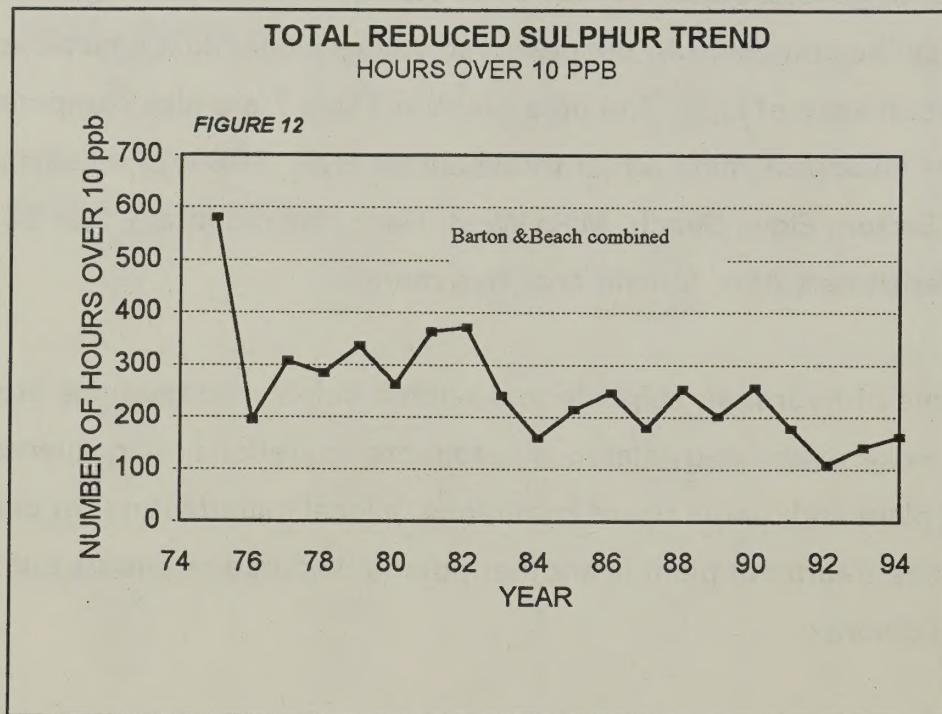
These gases are comprised of hydrogen sulphide (H_2S), the "rotten egg" gas and other sulphur compounds and the mixture is referred to as total reduced sulphur (TRS). There are no general objectives for TRS. However, an hourly objective for H_2S of 20 ppb may be compared to the observed values since most emissions are thought to consist mainly of H_2S . The data given in Table 7 are also compared to the 10 ppb level - an approximate odour threshold for H_2S . TRS was measured at seven stations - Barton, Elgin, Beach, Main West, Nash, the mountain, Pier 25 and a new site on Vansitmart Ave. for the final five months.

The major sources of hydrogen sulphide and related sulphur compounds are the steel industry's coke ovens and related by-products operations, slag quenching processes, a tar plant and, under upset conditions, a local manufacturer of carbon black. The sewage treatment plant is another potential source of odours but only during upset conditions.

The Beach Blvd area remained the most seriously affected location by TRS. The 29102 - Beach Blvd. station recorded 122 hours over 10 ppb in 1994, 34 of which were over 20 ppb. The Pier 25 site, closer to the industries, recorded 277 hours over 10 ppb, 78 of which were over 20 ppb. These totals were greater than those observed in 1993. Data indicate that Dofasco Inc. was the prime source affecting the Beach stations and others in the City. That company has been experimenting with methods of reducing emissions from slag quenching. The Ruetgers (formerly Carbochem) plant and Stelco are also sources, but to a much lesser degree.

The Barton station measured 41 hours above 10 ppb in 1994; the mountain station measured 9 such hours (all in the moderate range of the AQI); the Elgin/Kelly station downtown measured 41 hours over 10 ppb, 2 of which were in the Poor range of the AQI; Main West recorded 10 hours over 10 ppb, while the east end site measured one hour. In five months of operation, the new Vansitmart station recorded 12 hours over 10 ppb, 6 of which were over 20 ppb.

Figure 12 displays the trend of 10 ppb exceedences per year at the Beach and Barton stations - the two oldest sites. A decline is apparent but most of the decline relates to the Barton location. The Beach Blvd area still experiences numerous odourous concentrations of these contaminants.



In 1994 Dofasco submitted a proposal to study TRS emissions as a result of long standing Ministry data that indicated they were the major source of TRS at Beach Blvd. The plan calls for source identification and recommendations for remediation. Implementing this plan should result in long term reductions in TRS.

TABLE 7
TOTAL REDUCED SULPHUR

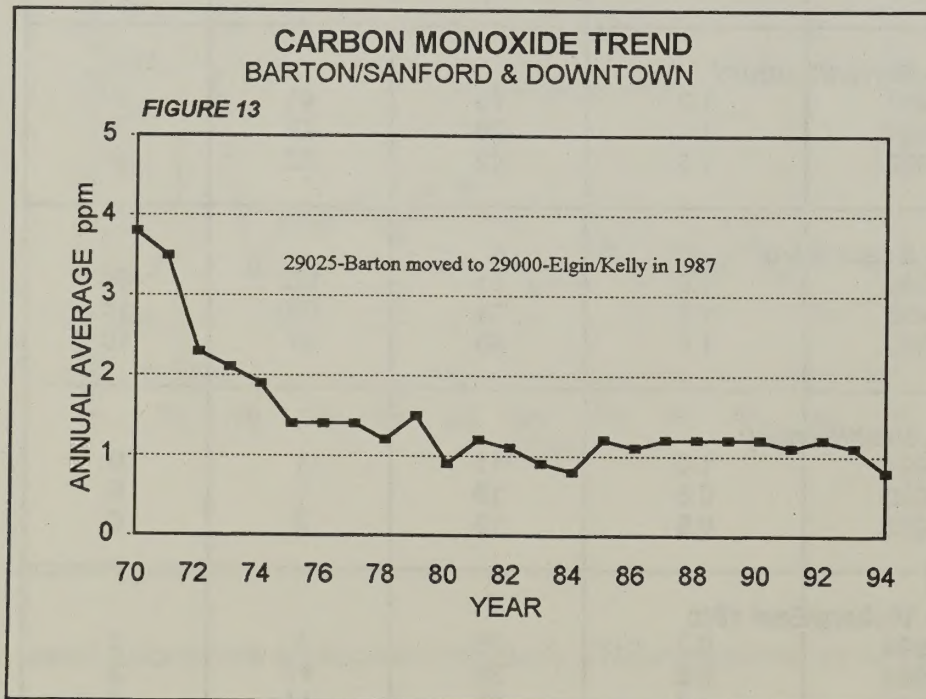
parts per billion

YEAR	ANNUAL AVERAGE	MAXIMUM 1 hr	No. Hours Over	
			10 ppb	20 ppb
29000 - Elgin/Kelly				
1994	1.1	47	41	8
1993	0.7	13	13	0
1992	0.6	24	12	1
29025 - Barton/Sanford				
1994	1.2	19	41	0
1993	1.4	26	42	3
1992	1.3	42	22	2
29102 - Beach Blvd				
1994	1.5	51	122	34
1993	1.5	31	100	14
1992	1.4	40	87	10
29105 - Nash/Kentley				
1994	1.0	11	1	0
1993	0.6	10	0	0
1992	0.6	13	2	0
29114 - Vickers/East 18th				
1994	0.7	26	9	1
1993	0.8	36	17	2
1992	0.5	20	11	0
29118 - Main West				
1994	0.7	16	10	0
1993	0.6	16	12	0
1992	0.4	13	2	0
29547 - Pier 25				
1994	2.7	355	277	78
1993	2.1	44	166	24
29561 - Vansitmart/Strathearne				
1994 (5 months)	1.4	118	12	6

Ontario Objectives: 20 ppb (1 hour - Hydrogen sulphide)

4.6 Carbon Monoxide

The major source of carbon monoxide is the automobile although there are also some contributions from industry. Due to the requirements for automotive emission controls through the years, the levels measured at Barton Street (moved to Elgin/Kelly in 1987) have decreased greatly since the 1970's (Figure 13).



In 1994 the levels were lower than the previous few years and were well below the objectives which are based on health effects. Main West recorded slightly lower levels than downtown, despite the presence of the 403 highway cutoff. Data are given in Table 8. All AQI readings (both 1-hour and 8-hour) fell in the Very Good range.

**TABLE 8
CARBON MONOXIDE**

parts per million

YEAR	ANNUAL AVERAGE	MAXIMUM		No. Times Over Objective	
		1 hr	8 hr	1 hr	8 hr
29000 - Elgin/Kelly					
1994	0.8	7	3	0	0
1993	1.1	6	4	0	0
1992	1.2	8	4	0	0
29118 - Main West					
1994	0.7	6	3	0	0
1993	0.8	5	4	0	0
1992	0.7	5	4	0	0

Ontario Objectives: 30 ppm (1 hour)

13 ppm (8 hour)

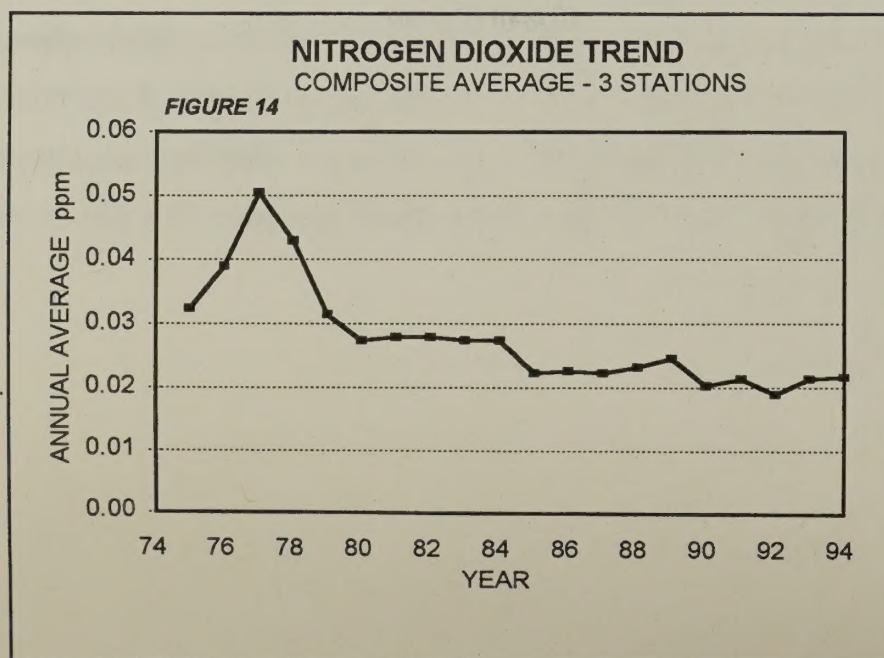


4.7 Oxides of Nitrogen

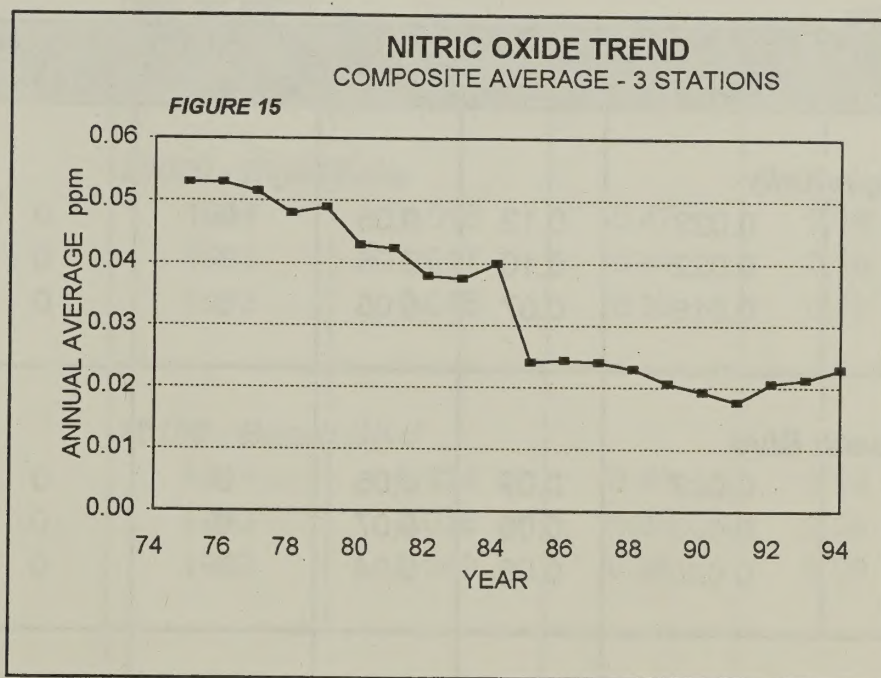
The primary sources of oxides of nitrogen are high temperature combustion sources including the automobile. The most abundant oxides are nitric oxide (NO) and nitrogen dioxide (NO₂). Nitric oxide is a direct emission which is then oxidized in the atmosphere to form nitrogen dioxide. Both pollutants were monitored continuously at Elgin/Kelly, Main West, Beach Blvd. and the mountain. At each station, a single instrument makes measurements of NO, NO₂ and total nitrogen oxide. Nitric oxide is measured directly, and the total oxides are measured by internally converting all other nitrogen oxides to nitric oxide. The instrument then determines nitrogen dioxide to be the difference between the first two measurements.

Objectives exist only for nitrogen dioxide and these are based on odour threshold levels (hourly) and health effects (24-hourly). Other adverse effects occurring at much higher levels include vegetation damage, reduced visibility and corrosion of metals. The objectives were not exceeded in 1994, similar to previous years.

Data for nitrogen dioxide are given in Table 9 and a combined yearly trend is illustrated in Figure 14. A slight downward trend is evident. All four stations recorded similar averages.



Data for nitric oxide are given in Table 10 and a combined yearly trend is given in Figure 15. The abrupt decrease in levels shown in the figure was caused by the move of the Beach Blvd station away from the direct influence of the QEW highway. That station is now much less affected by vehicle emissions.



The new Main Street West site recorded the highest levels. It is affected by traffic on Main Street West and the Highway 403 cutoff. The mountain station recorded the lowest average, it being the least influenced by traffic.

Oxides of nitrogen are an important factor in the photochemical cycle of ozone in the atmosphere. This will be discussed in the next section of this report.

TABLE 9
NITROGEN DIOXIDE

parts per million

YEAR		ANNUAL AVERAGE	MAXIMUM		No. Times Over Objective	
			1 hr	24 hr	1 hr	24 hr
29000 - Elgin/Kelly						
1994	0.022	0.12	0.06	0	0	
1993	0.022	0.10	0.06	0	0	
1992	0.019	0.07	0.05	0	0	
29102 - Beach Blvd						
1994	0.023	0.09	0.06	0	0	
1993	0.023	0.09	0.07	0	0	
1992	0.020	0.08	0.04	0	0	
29114 - Vickers/East 18th						
1994	0.018	0.09	0.05	0	0	
1993	0.018	0.10	0.06	0	0	
1992	0.017	0.09	0.05	0	0	
29118 - Main West						
1994	0.020	0.13	0.07	0	0	
1993	0.019	0.12	0.07	0	0	
1992	0.018	0.08	0.05	0	0	

Ontario Objectives: .20 ppm (1 hour)
.10 ppm (24 hour)

TABLE 10
NITRIC OXIDE

parts per million

YEAR	ANNUAL AVERAGE	MAXIMUM	
		1 hr	24 hr
29000 - Elgin/Kelly			
1994	0.018	0.47	0.18
1993	0.017	0.44	0.16
1992	0.015	0.32	0.10
29102 - Beach Blvd			
1994	0.024	0.40	0.19
1993	0.018	0.36	0.09
1992	0.019	0.38	0.08
29114 - Vickers/East 18th			
1994	0.008	0.41	0.07
1993	0.009	0.28	0.09
1992	0.008	0.21	0.06
29118 - Main West			
1994	0.027	0.55	0.25
1993	0.029	0.55	0.24
1992	0.028	0.50	0.18

Ontario Objectives: None

4.8 Ozone

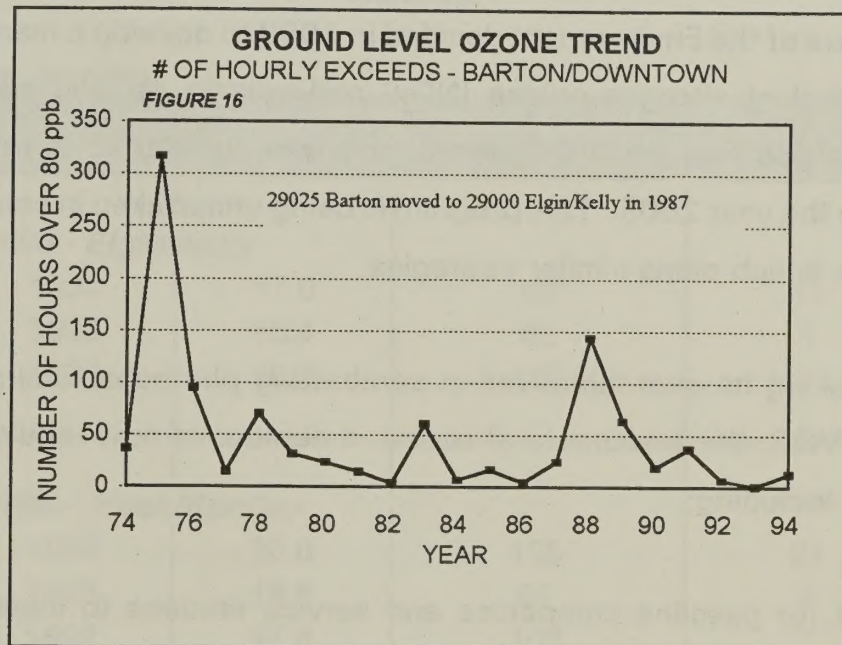
Oxidants are produced by photochemical reactions involving oxides of nitrogen, hydrocarbons and sunlight. Ozone accounts for most of the oxidants produced. The sources of the precursor pollutants are mainly industrial and automotive. The rate of oxidant production is dependent on the quantity of precursor pollutants, temperature and intensity of sunlight.

This report deals only with Ontario measurements of ground level ozone. However, regulations have been passed by the Ministry to control the use and disposal of CFCs (chlorofluorocarbons) which destroy upper level ozone.

At high altitudes, ozone (the "ozone layer") filters harmful ultra violet radiation from incoming sunlight, but at the earth's surface, it is an unwelcome pollutant where it is known to cause respiratory problems to humans and is also injurious to different types of vegetation including certain tobacco, bean and tomato crops. The one-hour objective for ozone (80 ppb) is based on such vegetation effects, however, jogging or other strenuous exercise outdoors is not advisable for sensitive people above such levels. Exercise increases breathing rates and thus increases the amount inhaled.

Ground level ozone concentrations follow very definite annual and daily trends. Highest levels occur during the summer (May - September), and the daily maxima usually occur during late afternoon. Both patterns are directly related to temperature and the amount and intensity of sunlight.

Ozone was measured at the four Air Quality Index stations. Data are summarized in Table 11 while yearly trends are illustrated in Figure 16. The trend from year to year is unstable, being largely dependent on the climate of the summer.



In 1994, the hourly objective was exceeded in a range from 13 to 44 hours at the four stations, more than the previous two years.

During each elevated ozone episode, winds were southwest and warm temperatures prevailed. The origin of most of the ozone is believed to be the United States. This is confirmed by stations close to the shore of Lake Erie. One such station at Long Point, upwind of all Canadian sources, measured 174 hours above the objective in 1994, the most in the Province. Canadian sources, including vehicles do contribute to the problem however.

Ozone, hydrocarbons and oxides of nitrogen can be transported over great distances and can be augmented by local sources. Paradoxically, Hamilton and other major urban areas usually experience lower ozone concentrations than their more rural surroundings during peak occurrences. This is due to the numerous high temperature combustion sources in cities which produce scavengers of ozone such as nitric oxide. Nonetheless, ozone and other oxidants remain a problem in the Hamilton area. Due to the complexity of oxidant formation and the long range

transport phenomenon, this problem will have to be resolved on a national and international rather than local scale.

In recognition of the seriousness of the ground level ozone problem, the Canadian Council of Ministers of the Environment decided in 1988 to develop a management plan for the control of nitrogen oxides (NO_x) and volatile organic compounds (VOC). A three phase No_x and VOC control plan was developed to resolve the ozone problem by the year 2005. This program is being undertaken in concert with the United States which plans similar strategies.

The Ministry is taking its own initiatives in combatting photochemical smog. To reduce NO_x and VOC, the precursors of ozone, a number of new regulations are being introduced including:

- The requirement for gasoline companies and service stations to install vapour recovery equipment on fuel tanks and trucks (by 1996).
- NO_x emissions from stationary turbines must be reduced from 200 ppm to 25 ppm.
- Refineries must produce gasolines which are less volatile during the summer.
- Dry cleaners will be required to undergo education programs by 1996 to minimise their VOC emissions
- Ontario Hydro has already reduced their NO_x emissions by 37 kilotonnes in the past 2 years.

Further, as an interim measure, the Ministry, in co-operation with Environment Canada, broadcasts air quality advisories for Southern Ontario related to the ozone monitoring program. When ozone levels are expected to reach 80 ppb or higher the next day, such a forecast will be included in normal weather reports. The public is advised to avoid strenuous exercise, and that sensitive individuals may experience respiratory symptoms and should alter their activities accordingly. The public is encouraged to reduce their use of automobiles, to car pool, to use public transit and to avoid the use of oil based paints and solvents and gasoline powered equipment such as lawn mowers.

TABLE 11
OZONE

parts per billion

YEAR	ANNUAL AVERAGE	MAXIMUM 1 hr	No. Times Over 1 hr Objective
29000 - Elgin/Kelly			
1994	17.0	96	13
1993	16.4	82	1
1992	16.9	100	7
29105 - Nash/Kentley			
1994	20.0	126	21
1993	18.8	87	5
1992	17.8	103	7
29114 - Vickers/East 18th			
1994	22.9	119	44
1993	21.0	95	8
1992	18.9	112	15
29118 - Main West			
1994	19.1	103	14
1993	16.7	78	0
1992	16.6	109	11

Ontario Objectives: 80 ppb(1 hour)

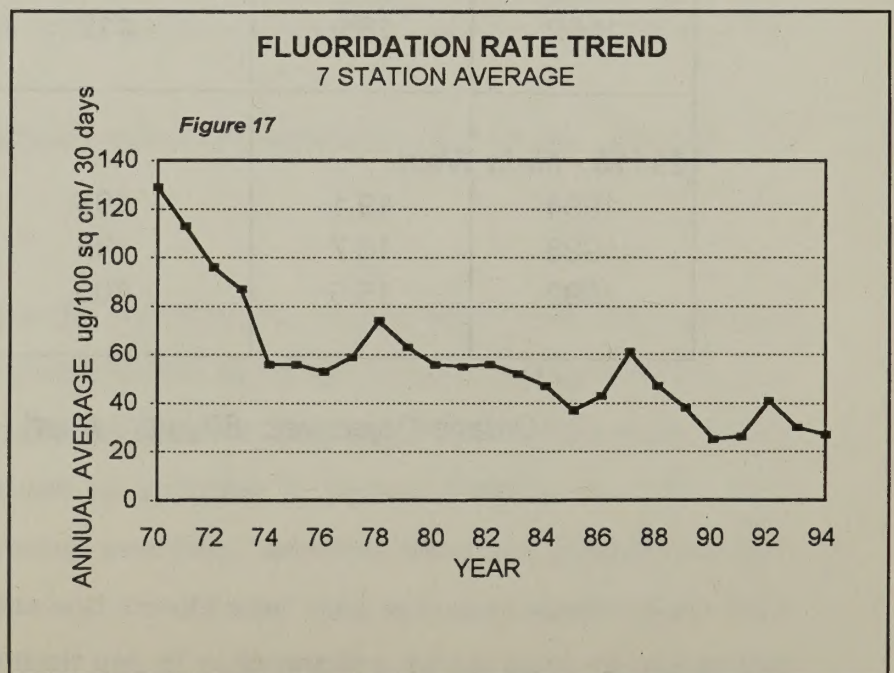
4.9 Fluoridation

This measurement is a relatively simple assessment used to determine quantities of various fluoride compounds in the ambient air. A lime coated paper is exposed to the atmosphere for one month and is then chemically analyzed for fluoride. The fluoride objectives are based on vegetation damage and for this reason, the objective is more stringent during the growing season. For the period of April to October the objective is 40 micrograms/100 square centimetres/ 30 days while for the remainder of the year it is 80.

In Hamilton, the major fluoride sources are the basic oxygen furnaces used by the major steel industries which require fluorspar as a fluxing agent and a brick manufacturing plant at the base of the escarpment near Gage Park. In addition to these process emissions, there are other minor sources such as coal burning, since coal contains trace amounts of fluoride.

Data are summarized in Table 12 and the yearly trend since 1970 is illustrated in Figure 17.

The trend graph shows that levels have declined steadily to the point that the monthly objectives were only occasionally exceeded. Except for a peak in 1992, the readings have been stable for the past 5 years. The trend graph does not include data from the Hamilton Brick plant to be discussed below.



A contour plot of yearly averages is given in Figure 18. A small ring can be drawn near the industrial area as shown. The worst station within this area recorded four samples above the monthly objectives in 1994, but no other station measured more than two (except for the Hamilton Brick sites).

The most prominent individual source of airborne fluoride in the city is the Hamilton Brick Co., near Gage Park. A network of five monitors recorded high levels well above objectives again in 1994.

Elevated fluoride concentrations near brick plants are common. A 1983 report undertaken jointly by the Ontario Ministries of Environment, Health and Labour concluded that " the maximum additional intake of fluoride resulting from exposure to brick plant fluoride emissions is small. It is concluded that this additional intake could be considered to fall within the normal range of fluoride intake from dietary sources and as such would not be expected to induce health effects in an exposed population" (p. 24). This report was based on measurements near a Toronto and a Brampton brick plant. Concentrations in Toronto and Brampton were comparable to those measured at the Hamilton stations.

Although human health concerns are not a problem, light to severe injury to sensitive vegetation (mostly silver maple) has been observed in the vicinity of the plant in 1986, 1987 and 1991 surveys. Injury and fluoride concentrations in the vegetation decreased with distance from the brick plant.

Hamilton Brick Co. has upgraded their drying ovens and reduced the temperatures used in the process in conjunction with the installation of more efficient kilns. These modifications have had little effect in a reducing fluoride levels surrounding the plant. The company has failed to voluntarily reduce fluoride emissions to acceptable levels. The Ministry is proceeding with mandatory abatement in the form of a Control Order.

TABLE 12
FLUORIDATION RATE

Ontario Objectives: 40 ug/100 cm/30 days (April - October)

80 ug/100 cm/30 days (November - March)

micrograms per square centimetre per 30 days

STATION NUMBER	LOCATION	AVERAGE			MAX 1994	No. of Months Over Objective (1994)
		1992	1993	1994		
29001	Hughson/Hunter	32	30	17	24	0
29012	Burlington/Wellington	26	16	15	19	0
29025	Barton/Sanford	47	33	21	30	0
29054	Beach/Conrad	33	28	23	51	1
29059	Burlington/Gage	65	43	37	48	2
29062	King E/Cochrane	48	42	45	70	4
29066	Killarney/Beach Blvd	40	29	28	36	0
29115	London/Justine	122	98	146	259	9
29116	Dalkeith/Ottawa	44	38	21	27	0
29119	Morley/Parkdale	42	26	20	30	0
29120	Dickson/Burlington	73	77	62	130	4
29126	Rosslyn/Montclair	116	95	93	278	7
29127	Lawrence/Balmoral	616	448	549	931	11
29129	Province/Justine	85	65	81	152	8
29131	Central/Graham	57	42	54	90	5

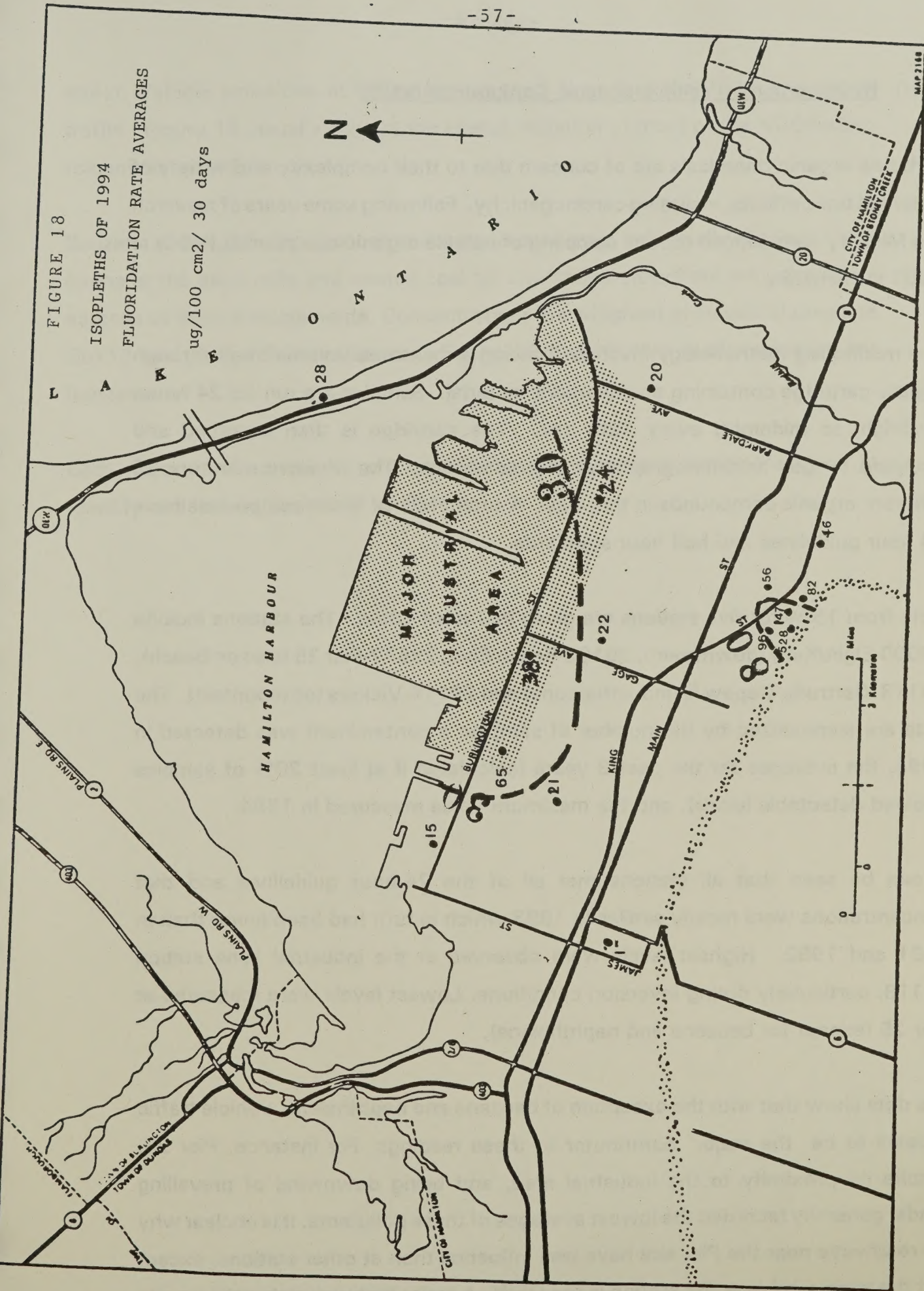
11 Months of data for each station in 1994. June results unavailable.

FIGURE 18

ISOPLETHS OF 1994

FLUORIDATION RATE AVERAGES

ug/100 cm²/ 30 days



4.10 Hydrocarbons - Volatile Organic Compounds (VOC)

Airborne organic chemicals are of concern due to their complexity and variety of potential toxic effects, including carcinogenicity. Following some years of research the Ministry commenced routine sampling of volatile organic compounds (VOC) in 1991 in Hamilton.

The monitoring methodology involves drawing a measured volume of air through a glass cartridge containing an adsorbent material. Samples are run for 24 hours (midnight to midnight) every 12th day. The cartridge is then desorbed and analyzed by gas chromatography at the laboratory. The Ministry monitors 35 different organic compounds in this way. A total of 21 of these compounds have 24 hour guidelines and half hour standards.

Data from 1994 for five stations are given in Tables 13a-c. The stations include 29000-Elgin/Kelly (downtown), 29102-Beach Blvd, 29547-Pier 25 (also on Beach), 29113 -Gertrude/Depew (in industrial zone) and 29114-Vickers (on mountain). The data are summarized by the number of samples a contaminant was detected in 1994, the averages for the past 3 years (calculated if at least 20% of samples showed detectable levels), and the maximum value measured in 1994.

It can be seen that all stations met all of the 24-hour guidelines and that concentrations were mostly similar to 1993 which in turn had been lower than in 1991 and 1992. Highest levels were observed at the industrial zone station 29113, particularly during inversion conditions. Lowest levels were measured at Pier 25 (except for benzene and naphthalene).

The data show that with the exception of benzene and naphthalene, vehicle traffic appears to be the major contributor to these readings. For instance, Pier 25, despite its proximity to the industrial area, and being downwind of prevailing winds, generally recorded the lowest averages of these pollutants. It is unclear why the roadways near the Pier site have less influence than at other stations, except that the main road near the station is the QEW - a major highway rather than a city

street. Vehicle emissions at higher speeds tend to be less than from low speed traffic. Figure 19 visually depicts the spatial variation of most of the VOCs using toluene as an indicator.

Benzene and naphthalene concentrations appeared more industrially oriented. Coke ovens at the steel mills and related coal tar operations elsewhere are known key sources of these contaminants. Concentrations were highest at industrial zone site 29113 and at the Beach stations. Figure 20 depicts this spatial variation for benzene.

Both major steel companies are participating in long term abatement plans to identify and reduce their VOC emissions.

TABLE 13a
VOLATILE ORGANICS (VOC) - 1994

micrograms per cubic metre

24 HR GUIDELINE	No of Defects	29000 - Elgin/Kelly				Max 1994
		1994	Average 1993	1992	1991	
VINYL CHLORIDE	1					0.1
1,3-BUTADIENE	17	0.1	0.1		0.2	0.3
ISOPRENE	20	0.2	0.2	0.2	0.3	0.4
1,1-DICHLOROETHENE	23	0.1	0.2	1.0	0.6	0.3
ACRYLONITRILE	2					0.1
DICHLOROMETHANE	27	2.7	0.9	1.9	1.5	28.0
1,1-DICHLOROETHANE	2					0.7
HEXANE	27	3.9	4.3	10.6	15.7	16.4
TRICHLOROMETHANE	8	0.1	0.1	0.4	0.4	0.1
1,2-DICHLOROETHANE	0					
CYCLOHEXANE	24	0.2	0.3	0.5	0.3	0.9
CARBON TETRACHLORIDE	27	0.4	0.4	3.4	0.7	0.4
BENZENE	27	2.2	3.0	4.8	3.3	5.8
TRICHLOROETHYLENE	17	0.1		0.2	0.2	0.8
1,1,1-TRICHLOROETHANE	27	1.6	3.1	1.2	1.4	2.8
1,2-DICHLOROPROPANE	0				0.2	
BROMODICHLOROMETHANE	0					
CIS-1,3-DICHLOROPROPENE	0					
TOLUENE	27	5.1	5.9	8.4	7.2	16.6
1,1,2-TRICHLOROETHANE	0					
CHLOROMETHANE	0					
TETRACHLOROETHYLENE	26	0.9	1.7	3.7	3.0	6.9
CHLOROBENZENE	0					
ETHYLBENZENE	27	0.9	0.9	1.6	1.3	3.1
M-XYLENE	27	2.9	3.1	5.0	4.2	11.0
STYRENE	17	0.1	0.1	0.5	0.4	0.6
O-XYLENE	27	1.0	1.0	1.6	1.4	4.0
1,1,2,2-TETRACHLOROETHANE	1			0.4	0.2	0.1
a-PINENE	15	0.5				2.7
1,3,5-TRIMETHYLBENZENE	27	0.5	0.5	0.7	0.6	2.3
1,2,4-TRIMETHYLBENZENE	27	1.7	1.4	1.6	1.8	7.5
1,3-DICHLOROBENZENE	3					0.2
1,4-DICHLOROBENZENE	22	0.2	0.3	0.2	0.3	1.2
1,2-DICHLOROBENZENE	3					0.2
NAPHTHALENE	24	1.6				8.2

No of Defects	29113 - Gertrude/Depew				Max 1994
	1994	Average 1993	1992	1991	
0					
6	0.1	0.1	0.1		0.2
23	0.2	0.1	0.2		0.5
12	0.1	0.2	1.2		0.2
0					
25	1.5	0.5	1.4		10.2
0					
25	2.8	2.2	4.4		8.8
13	0.1	0.9	0.3		0.2
0					
24	0.3	0.2	0.5		0.9
25	0.4	0.4	1.6		1.2
25	6.3	3.7	7.3		42.0
22	0.2	0.1	0.2		0.5
25	1.4	2.2	4.8		3.7
0					
0				0.6	
0					
25	7.4	6.6	7.1		27.5
0				0.4	
0				0.5	
23	0.5	0.4	0.8		2.5
0					
25	1.4	1.2	1.6		5.1
25	4.9	4.4	3.6		15.0
22	0.3	0.2	0.4		1.2
25	1.7	1.4	1.7		6.2
0				0.2	
11	0.1				0.7
25	0.7	0.7	1.2		3.2
25	2.1	1.8	2.9		9.7
0				0.4	
21	0.2	0.2	0.5		1.0
0				0.2	
24	3.1	2.0	1.0		12.2

No of Defects	29547 - Pier 25				Max 1994
	1994	Average 1993	1992	1991	
0					
4					0.4
13	0.1				0.3
4		0.1	0.3		0.1
0					
25	1.0	0.4	1.0		5.1
1					0.2
27	1.0	1.0	1.4		2.7
10	0.1	1.9	0.2		0.1
1					0.1
21	0.1	0.1	0.2		0.4
27	0.4	0.5	0.3		0.5
27	4.0	4.2	4.3		8.3
16	0.2	0.1			1.2
27	0.7	1.1	1.0		1.3
0					
0					
0					
27	2.7	2.9	2.3		6.3
0					
0					
24	0.2	0.2	0.5		0.8
1				0.1	0.1
26	0.6		0.6		1.6
27	2.0	1.6	1.9		5.6
15	0.1		0.5		0.3
27	0.7	0.5	0.5		2.0
1					0.1
10	0.1				0.2
23	0.2	0.2	0.9		0.7
27	0.7	0.5	2.2		2.7
1					0.3
6	0.1	0.1	0.1		0.3
1					0.4
23	2.4				7.8

TABLE 13b
VOLATILE ORGANICS (VOC) - 1994
micrograms per cubic metre

24 HR GUIDELINE	29102-Beach Blvd				29114 - Vickers/East 18th			
	No of Defects	Average	1991	Max 1994	No of Defects	Average	1991	Max 1994
VINYL CHLORIDE	0				1			0.2
1,3-BUTADIENE	10	0.1	0.1	0.3	14	0.1	0.1	0.2
ISOPRENE	12	0.2	0.2	0.8	19	0.1	0.2	0.3
1,1-DICHLOROETHENE	8	0.1	0.6	1.5	9	0.1	1.4	1.6
ACRYLONITRILE	0				0			
DICHLOROMETHANE	22	2.4	1.3	21.0	27	4.0	2.2	41.1
1,1-DICHLOROETHANE	2	0.1		0.1	0			
HEXANE	22	1.5	1.2	3.8	27	1.2	2.4	4.1
TRICHLOROMETHANE	11	0.1	0.4	0.1	12	0.1	1.2	0.1
1,2-DICHLOROETHANE	0		0.1		0			
CYCLOHEXANE	20	0.2	0.1	0.5	23	0.1	0.6	0.5
CARBON TETRACHLORIDE	22	0.5	2.1	0.7	26	0.4	0.3	0.5
BENZENE	22	4.3	3.4	9.5	27	1.9	3.9	6.9
TRICHLOROETHYLENE	18	0.1	0.2	0.4	12	0.1	0.3	0.4
1,1,1-TRICHLOROETHANE	22	0.9	1.5	1.8	26	0.6	1.3	1.6
1,2-DICHLOROPROPANE	0				0			
BROMODICHLOROMETHANE	0				0			
CIS-1,3-DICHLOROPROPENE	0				0			
TOLUENE	22	3.5	3.6	7.2	27	3.0	3.6	9.0
1,1,2-TRICHLOROETHANE	0				0			
CHLOROMETHANE	0				0			
TETRACHLOROETHYLENE	20	0.2	0.5	0.5	22	0.3	0.4	1.4
CHLOROBENZENE	0				1			0.1
ETHYLBENZENE	22	0.7	0.8	1.9	27	0.6	0.7	2.9
M-XYLENE	22	2.5	2.3	6.8	27	2.0	1.5	10.0
STYRENE	16	0.2	0.3	0.5	11	0.1	0.2	0.5
O-XYLENE	22	0.8	0.8	2.3	27	0.7	0.8	3.5
1,1,2,2-TETRACHLOROETHANE	0				0			
a-PINENE	12	0.2		0.4	16	0.2		0.9
1,3,5-TRIMETHYLBENZENE	22	0.3	0.3	0.8	25	0.3	0.9	1.5
1,2,4-TRIMETHYLBENZENE	22	1.0	0.8	2.9	27	1.0	0.9	5.1
1,3-DICHLOROBENZENE	0				1			0.1
1,4-DICHLOROBENZENE	3	0.1	0.1	0.3	15	0.1	0.1	0.6
1,2-DICHLOROBENZENE	0				1			0.2
NAPHTHALENE	20	3.3	3.1	9.8	24	1.2	1.4	5.5

FIGURE 19

TOLUENE 1994

AVG(MAX)

UG/M3

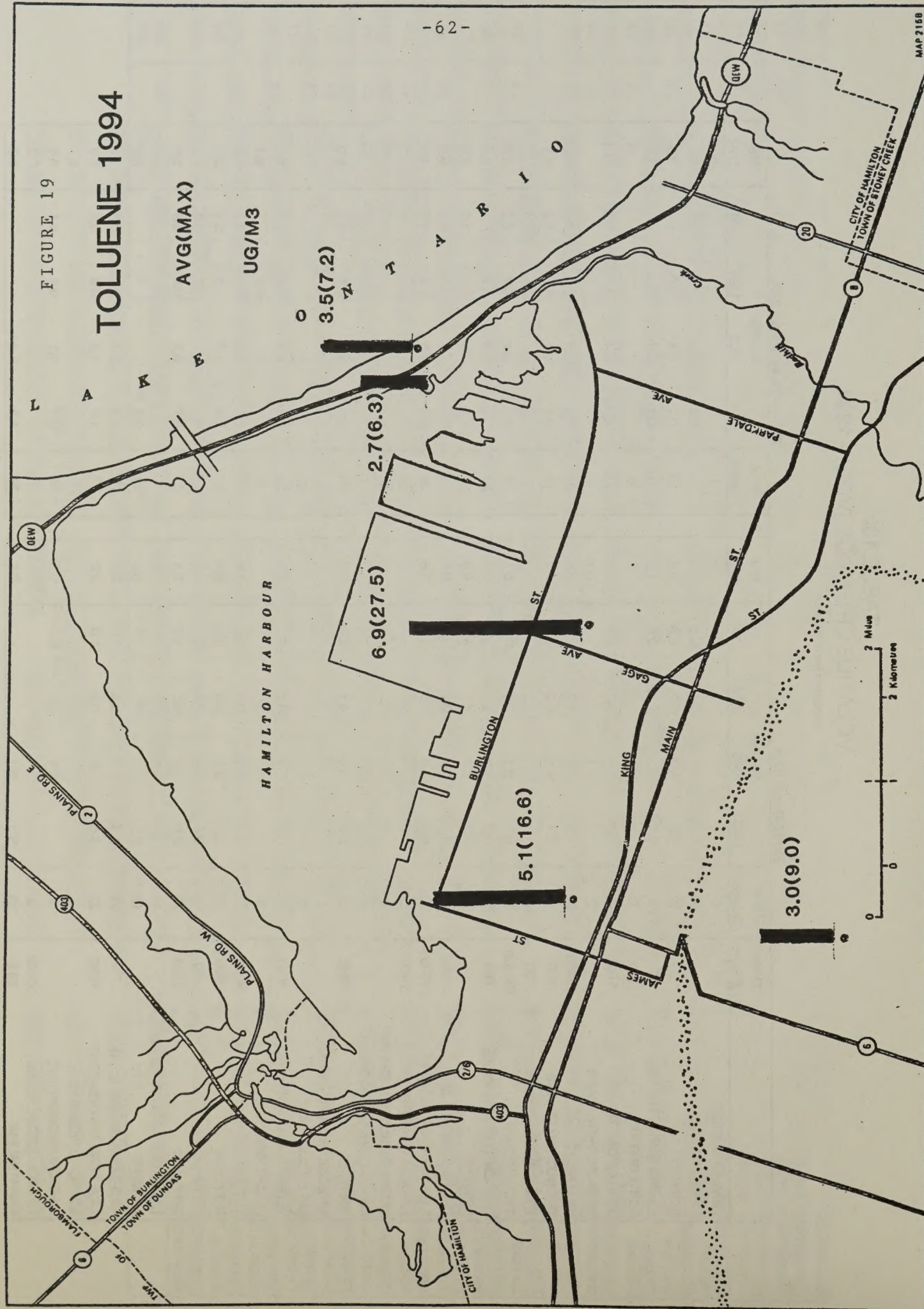
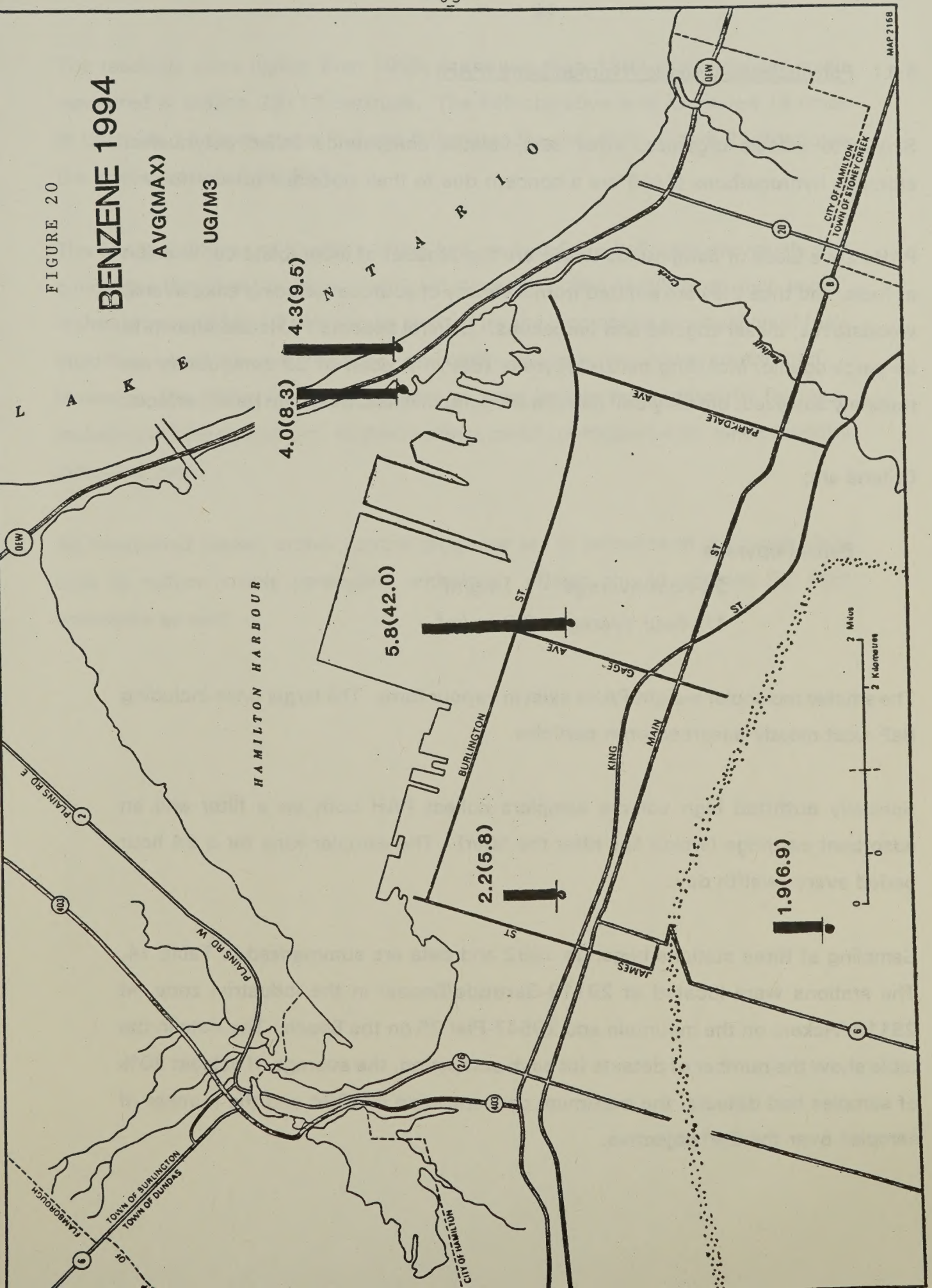


FIGURE 20

BENZENE 1994

AVG(MAX)

UG/M3



4.11 Polynuclear Aromatic Hydrocarbons (PAH)

Similar to volatile organics, other semi-volatile compounds called polynuclear aromatic hydrocarbons (PAH) are a concern due to their potential toxic effects.

PAHs are a class of compounds which are the product of incomplete combustion of fuels, and thus they are emitted from a variety of sources including coke ovens, woodstoves, diesel engines and barbecues. Several specific PAHs are known to be carcinogenic, including benzo(a)pyrene (BaP). A scan of 29 compounds are routinely analyzed, but only BaP has standards/guidelines, based on health effects.

Criteria are:

Benzo(a)pyrene

24-hour average - 1.1 ng/m^3

1/2-hour average - 3.3 ng/m^3

The smaller molecular weight PAHs exist in vapour form. The larger ones including BaP exist mostly adsorbed onto particles.

Specially outfitted high volume samplers collect PAH both on a filter and an adsorbent cartridge (which lies after the filter). The sampler runs for a 24 hour period every twelfth day.

Sampling at three stations began in 1992 and data are summarized in Table 14. The stations were located at 29113-Gertrude/Depew in the industrial zone, at 29114-Vickers on the mountain and 29547-Pier 25 on the Beach. The data in the table show the number of detects for each compound, the average, if at least 20% of samples had detects, the maximum concentration in 1994 and the number of samples over the BaP objective.

The readings were higher than 1993, but lower than 1992, with highest levels measured at station 29113-Gertrude. The BaP objective was exceeded 19 times at Gertrude, 15 times at the Pier and 6 times on the mountain. Figure 21 illustrates the spatial variation for BaP.

The Medical Officer of Health's office has reviewed the BaP data previously and concluded that there is not a significant threat to public health from such levels. It should be noted that PAHs can be emitted by any incomplete combustion of fuels including wood stoves/fireplaces, and such sources may have contributed. However, the higher levels did appear to arise largely from industrial facilities, including coking operations. Higher readings clearly correlated with winds from the industrial zone.

As mentioned earlier, active control programs are in progress at the major steel mills to reduce visible particulate emissions. These should address the PAH emissions as well.

TABLE 14

POLYNUCLEAR AROMATIC HYDROCARBONS (PAH) IN HAMILTON - 1994

nanograms per cubic metre

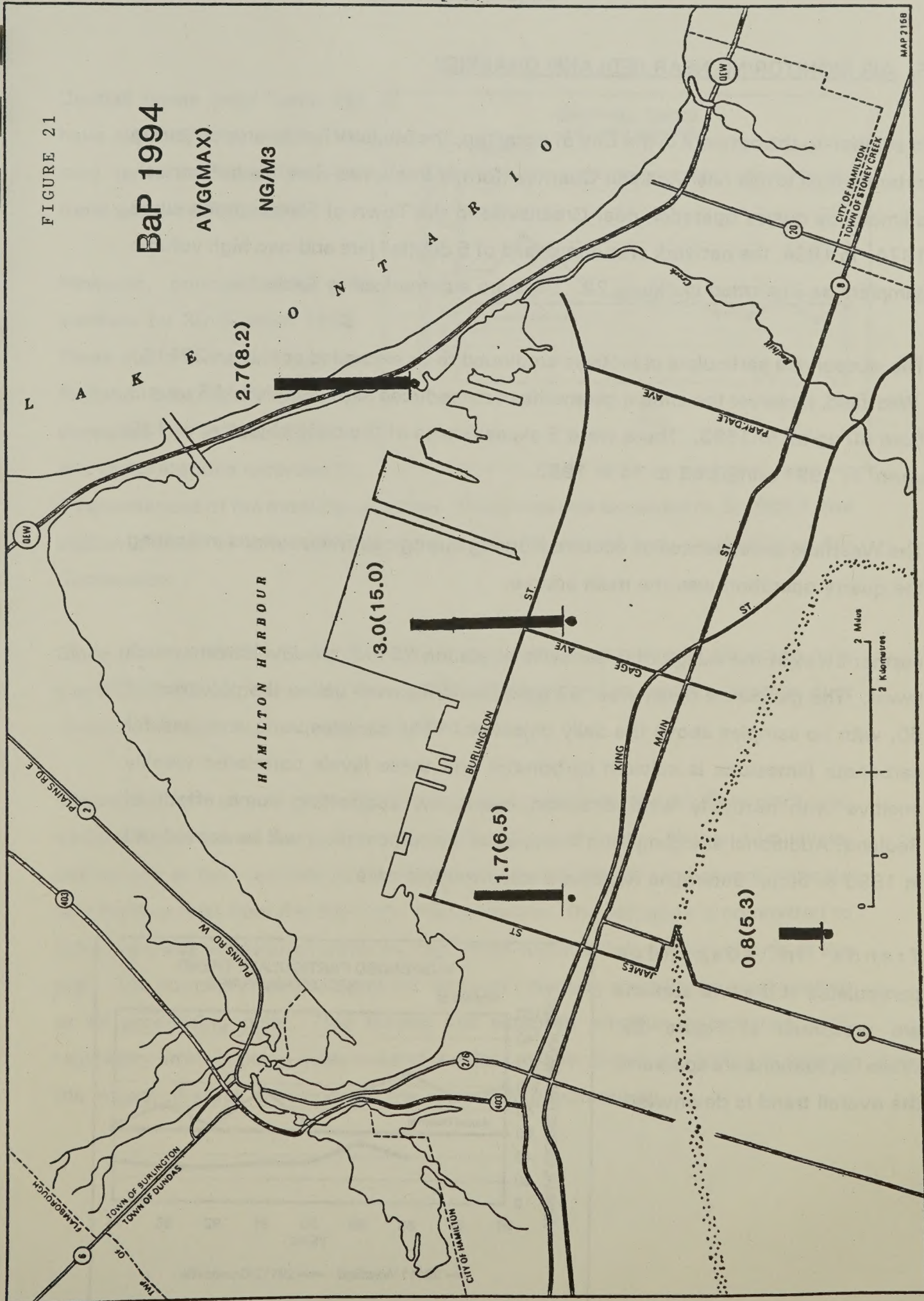
24 Hour Objective	29113 - Gertrude/Depew					29547 - Pier 25					29114 - Vickers/East 18th				
	No of Defects	Average		Max 1994	No. Times Over Obj.	No of Defects	Average		Max 1994	No. Times Over Obj.	No of Defects	Average		Max 1994	No. Times Over Obj.
		1994	1993				1994	1993				1994	1993		
PAH TOTAL	27	330.6	219.6	515.5	1273.5	23	292.26	260.9	345.4	773.5	25	107.47	98.4	133.9	361.0
2-CHLORONAPHTHALENE	2			0.4		0					1			0.4	
BIPHENYL	27	28.5	20.4	44	113.0	23	22.6	19.7	26.2	49.0	25	11.6	12.5	16.2	29.6
ACENAPHTHYLENE	27	35.7	28.3	49.2	109.9	23	24.2	24.3	32.4	84.8	24	11.9	9	16.6	53.9
ACENAPHTHENE	27	49.1	18	130.4	325.5	23	58.3	47.9	101.3	315.9	25	13.4	10.4	25.9	57.0
FLUORENE	27	40.9	23.5	49.6	196.9	23	37.1	27.1	32.2	113.1	25	14.2	13.3	15.6	41.0
PHENANTHRENE	27	83.9	52.7	129	463.9	23	65.8	55.6	56.1	195.1	25	28.2	27.2	26.3	112.7
ANTHRACENE	25	15.9	7.9	13.1	185.8	23	6.9	9.7	9.9	21.1	24	1.8	1.8	3.4	7.5
O-TERPHENYL	15	0.2	0.3	0.4	0.5	4				0.2	4				0.3
1-METHYLPHENANTHRENE	27	3.5	2.8	5.9	11.4	23	3.2	2.9	3.8	6.6	25	1.2	1.2	1.9	3.0
FLUORANTHENE	27	23.0	19.1	28.8	78.8	23	23.0	21.4	31.7	50.0	25	8.0	8.1	8.8	28.0
PYRENE	27	16.5	15.1	19.8	44.6	23	16.3	19.3	21.5	36.0	25	5.5	6.5	6.1	23.0
9,10-DIMETHYLANTHRACENE	0-					0					1				1.5
M-TERPHENYL	26	0.2	0.2		0.4	19	0.2	0.1		0.4	16	0.1	0.1		0.3
P-TERPHENYL	0					1				0.3	0				
BENZO(A)FLUORENE	27	2.1	1.6	4.3	7.9	23	2.0	2.1	2.3	4.7	25	0.6	0.6	1.6	3.2
BENZO(B)FLUORENE	27	2.0	1.3	3.1	8.5	22	1.9	1.6	1.8	4.5	15	0.6	0.4	1	3.5
BENZO(A)ANTHRACENE	27	4.1	3.1	6	17.0	23	3.7	3.9	2.9	8.9	25	1.2	0.8	1.5	7.0
TRIPHENYLENE	0					0					0				
CHRYSENE	27	5.7	4.6	6.1	19.7	23	6.3	5.6	3.8	20.0	24	2.0	1.5	1.9	11.0
BENZO(B)FLUORANTHENE	27	4.0	3.3	10.5	15.0	23	4.3	3.7	4.4	14.2	24	1.5	1.1	2.6	7.9
BENZO(K)FLUORANTHENE	25	2.4	2.4		13.2	23	2.5	3.0		6.8	21	0.9	0.8		5.1
BENZO(E)PYRENE	27	3.5	2.9	3.4	13.0	23	3.7	3.5	1.9	10.4	25	1.3	1	1.1	7.5
BENZO(A)PYRENE	26	3.0	2.2	3.1	15.0	22	2.7	2.8	1.9	8.2	21	0.8	0.5	0.8	5.3
PERYLENE	21	0.6	0.4	0.8	2.4	19	0.6	0.6	0.5	1.8	8	0.2	0.1		0.9
3-METHYLCHLORANTHRENE	0					0					0				
INDENO(1,2,3-CD)PYRENE	27	4.1	2.7	3.9	13.5	23	3.5	3.3	1.9	11.9	23	1.6	0.8	1.3	9.0
DIBENZO(A,C)ANTHRACENE	21	0.8	0.4	0.8	5.9	21	0.6	0.5	0.8	1.6	14	0.3			1.2
DIBENZO(A,H)ANTHRACENE	0					0					0				
BENZO(GH)PERYLENE	27	2.5	1.9	3.7	9.9	23	2.4	2.2	2.6	7.4	22	0.9	0.7	1.2	5.5

FIGURE 21

BaP 1994

AVG(MAX)

NG/M3



5. AIR MONITORING NEAR REDLAND QUARRIES

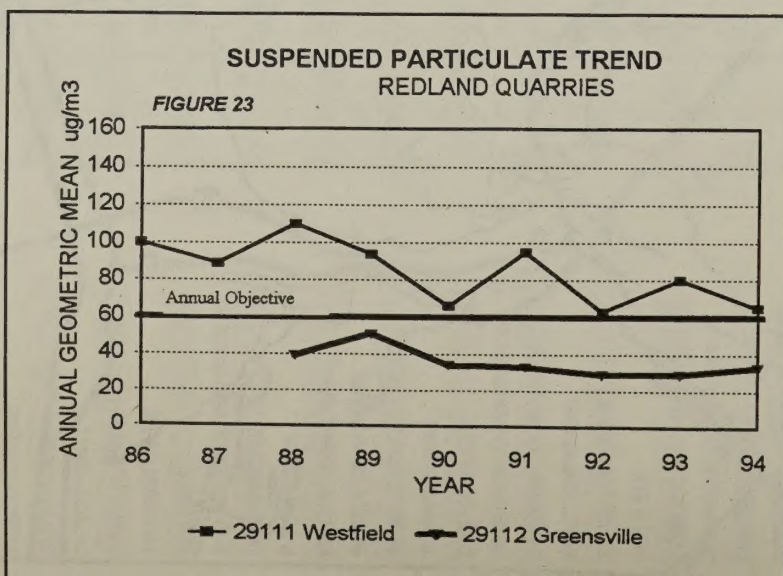
In addition to the network in the City of Hamilton, the Ministry has been monitoring airborne dust levels near Redland Quarries (former known as Steetley Industries), a limestone quarry operation near Greensville in the Town of Flamborough since 1974. In 1994, the network was comprised of 5 dustfall jars and two high volume samplers as illustrated in Figure 22. Data are summarized in Table 15.

The suspended particulate objectives continued to be exceeded at station 29111 - Westfield, however the annual geometric mean reduced significantly to 65 ug/m³ from 80 ug/m³ in 1993. There were 5 exceedences of the daily objective of 120 ug/m³ in 1994 compared to 14 in 1993.

The Westfield exceedences all occurred during strong southwest winds indicating the quarry operation was the main source.

Further away in the village of Greensville at station 29112, the levels were much lower. The geometric mean was 33 ug/m³ in 1994, well below the objective of 60, with no samples above the daily objective. The samples were analyzed for carbonate (limestone is calcium carbonate) and these levels correlated weakly positive with northerly wind direction frequency, suggesting some effect of Redland. Additional sampling with continuous instrumentation will be carried out in 1995 to better determine Redland's effect on this area.

Trends in suspended particulates at the two stations are presented in Figure 23. While fluctuations are apparent, the overall trend is downward.



Dustfall levels (also Table 15) have similarly improved in the long term as shown by the trend graph in Figure 24.

However, concentrations did increase by 30 % from 1993. Three stations surrounding the Redland processing plant all exceeded the annual objective and these stations recorded 2 -

4 exceedences of the monthly objective. There was one exceedance at 29097, the station closest to where the active quarrying is carried out, north of the 4th Concession.

Since the late 1980's Redland has instituted many dust controls, including new electrostatic precipitators at the processing plant and numerous fugitive dust control measures at the quarry and plant area.

The remaining dust sources at Redland processing plant are the dry fines plant, and various fugitive dust sources such as stock piles and roads. Higher dust levels, particularly at the Westfield Academy station, during higher wind speeds indicate that fugitive dust from the site is the main problem. The company is committed to reducing these emissions further through more fugitive dust control efforts at the plant. The company has also agreed to conduct voluntary compliance stack testing at its processing plant. This testing will establish whether compliance with regulatory limits is being achieved and the data will be used in modelling to assess the impact of stack emissions on the surrounding community.

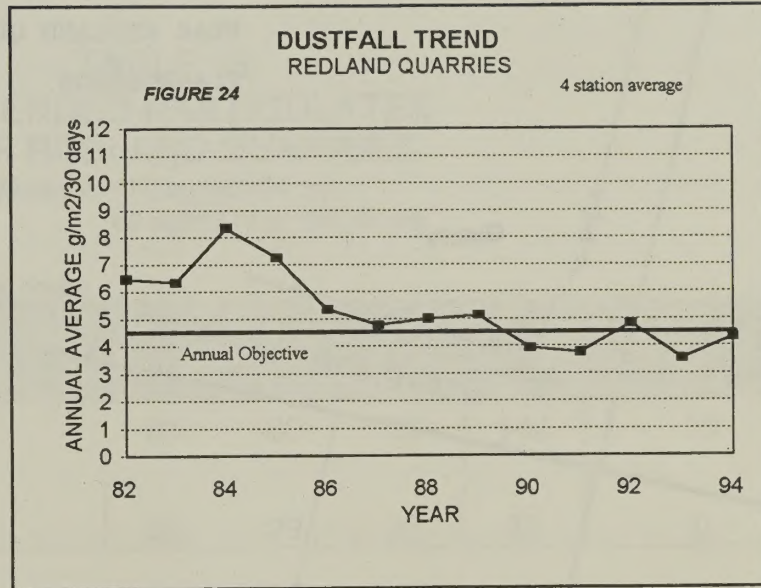


FIGURE 22

MAP OF SAMPLING STATION LOCATIONS

NEAR REDLAND QUARRIES

FLAMBOROUGH

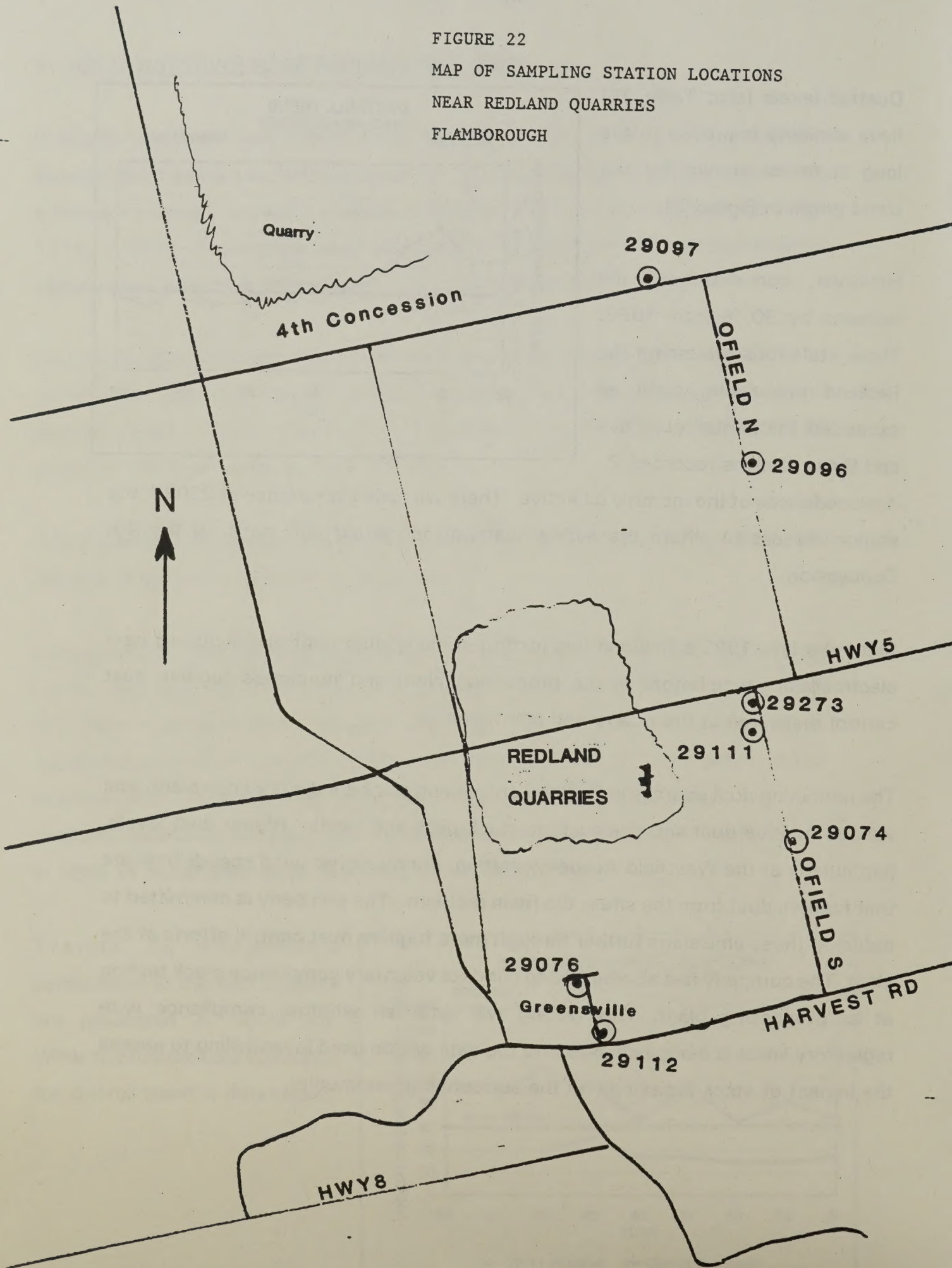


TABLE 15 SUSPENDED PARTICULATES NEAR REDLAND QUARRIES

Ontario Objectives: 120 ug/m³ (24 hr)
60 ug/m³ (1 yr geo.mean)

micrograms per cubic metre

STATION NUMBER	LOCATION	GEOMETRIC MEAN			MAX 1994	% SAMPLES > 120 (1994)
		1992	1993	1994		
29111	Ofield/Hwy 5	63	80	65	144	10
29112	Greenville	29	29	33	62	0

DUSTFALL NEAR REDLAND QUARRIES

Ontario Objectives: 7.0 g/m²/30 days (1 month)
4.5 g/m²/30 days (1 year average)

grams / square metre/ 30 days

STATION NUMBER	LOCATION	AVERAGE			MAX 1994	No. of Months > 7.0 (1994)
		1992	1993	1994		
29273	Ofield/Hwy 5	3.7	3.7	6.3	18.4	4
29074	Ofield S.	5.0	4.2	5.3	7.7	2
29076	Meldrum/Wesite	4.2	3.6	5.5	9.2	2
29096	Ofield n.	4.5	2.9	2.7	6.0	0
29097	4th Concession	5.6	3.5	3.8	7.5	1

6. DISCUSSION

There are three main air pollution problems in Hamilton. The first is the industrial impact on the nearby residential area, which includes occasional odours, organic pollutants and dust fallout. The second is short-term pollution build-ups throughout the city from vehicle traffic and industry during the spring and fall due to the presence of temperature inversions. The third problem is high ozone levels in summer, due to long range transport of pollutants. Ozone levels again exceeded objectives in 1994. As a long range pollution transport problem, it is being dealt with on a provincial, national and international basis. Nitrogen oxides/volatile organic contaminant control strategies are being implemented in both Canada and the United States and in Ministry generated programs in Ontario. The year 2005 has been targeted to eliminate the ozone problem.

Suspended particulate levels have decreased by 14% on average since 1988. The Air Pollution Index (API) reached the advisory level of 32 on three occasions during inversion conditions in 1994, all at the downtown station. The city's unique topography makes it very susceptible to inversions, during which times pollution build-ups are unavoidable, meaning such incidents will recur in the future. The frequency of these incidents is in decline however.

Dustfall levels throughout the city continued the decline which has been occurring since 1987. The 1994 levels were 30% less than those measured in 1986. The economic recession has probably helped reduce industrial emissions due to reduced production, however, efforts by industry to control point sources and fugitive sources by such techniques as the use of chemical sealants, road paving, road washing and landscaping, together with improved street cleaning practices by the City may also help to explain the trend. Further efforts must be made wherever possible. These can be both industrial and non-industrial in nature, such as controlling blow-off from unpaved areas, excavation, construction, demolition, road traffic and stock piles and related materials handling. Further controls on industrial point sources will also continue where necessary as well as improved operation and maintenance of existing pollution control equipment.

Despite the measured improvement, dustfall in the industrial zone continued to be a problem. Complaints of black fallout in that area, particularly during spring and fall inversion conditions continued to occur. Much of this fallout is industrially related and has prompted more intense air monitoring in the industrial zone in an attempt to pinpoint sources better. The Ministry has also set up a computerized video system aimed at the industrial zone to visually monitor the major pollution sources. The current Ministry focus is to ensure that adequate control equipment is in place and operated properly as well as trying to determine which specific industries are responsible for fallout incidents.

New measurements of organic chemicals indicated that volatiles such as xylenes and toluene were well within guidelines throughout the city. Other important volatiles including benzene, do not have guidelines, so the significance of these readings is unknown. Vehicle traffic appeared to be the dominant source for most of the contaminants except benzene and naphthalene. The industrial zone appeared to be the prime source of these contaminants. Other semi-volatile organics known as polynuclear aromatic hydrocarbons were also clearly industrially related and exceeded the guideline for one contaminant. Levels were highest in the industrial zone and at the Beach Strip. Control programs at the major steel mills are already underway to reduce these organic vapour emissions, and the ambient air monitoring will determine the success of these efforts.

Much of the air monitoring conducted in Hamilton is automated and linked via a Province-wide telemetry system. This system permits all of the Ministry's stations with continuous analyzers to send data directly to a central computer facility in Toronto allowing for data retrieval on a real-time basis. The system allows for immediate access to pollutant and wind/temperature data both in the Regional Office in Hamilton and in Toronto, and also allows for remote control and maintenance of the instruments. This results in a more efficient monitoring program.

One purpose of the telemetry system is to facilitate the Air Quality Index (AQI). The AQI is a function of six different pollutants which form up to eight separate

subindices. The highest hourly subindex becomes the AQI. Concentrations of sulphur dioxide, soiling index, carbon monoxide, nitrogen dioxide, total reduced sulphur and ozone are all individually converted to the old scale of index numbers (although not all AQI stations measure all six pollutants and eight subindices). The advisory or alert levels remain the same as previously 32, 50, 75, and 100. The old Air Pollution Index (API) has been retained as one subindex and will continue to be used for industrial action requests should the API reach or exceed 32.

In Hamilton, four separate AQIs are being reported for the east, west, mountain and downtown station at Elgin/Kelly.

The intent of the new index is to better inform the community about day to day air quality in a way which is quick and easy to understand.

7. References

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